60

DEPARTMENT OF
FISHERIES AND WILDLIFE
WESTERN AUSTRALIA

REPORT Nº 60

Published by the Director of Fisheries and Wildlife, Perth,
under the authority of the Hon. Minister for Fisheries and Wildlife

LIBRARY

SEP 11 1984

National Marine Fisheries Service
2570 Dole Street
Honolulu, Hawaii

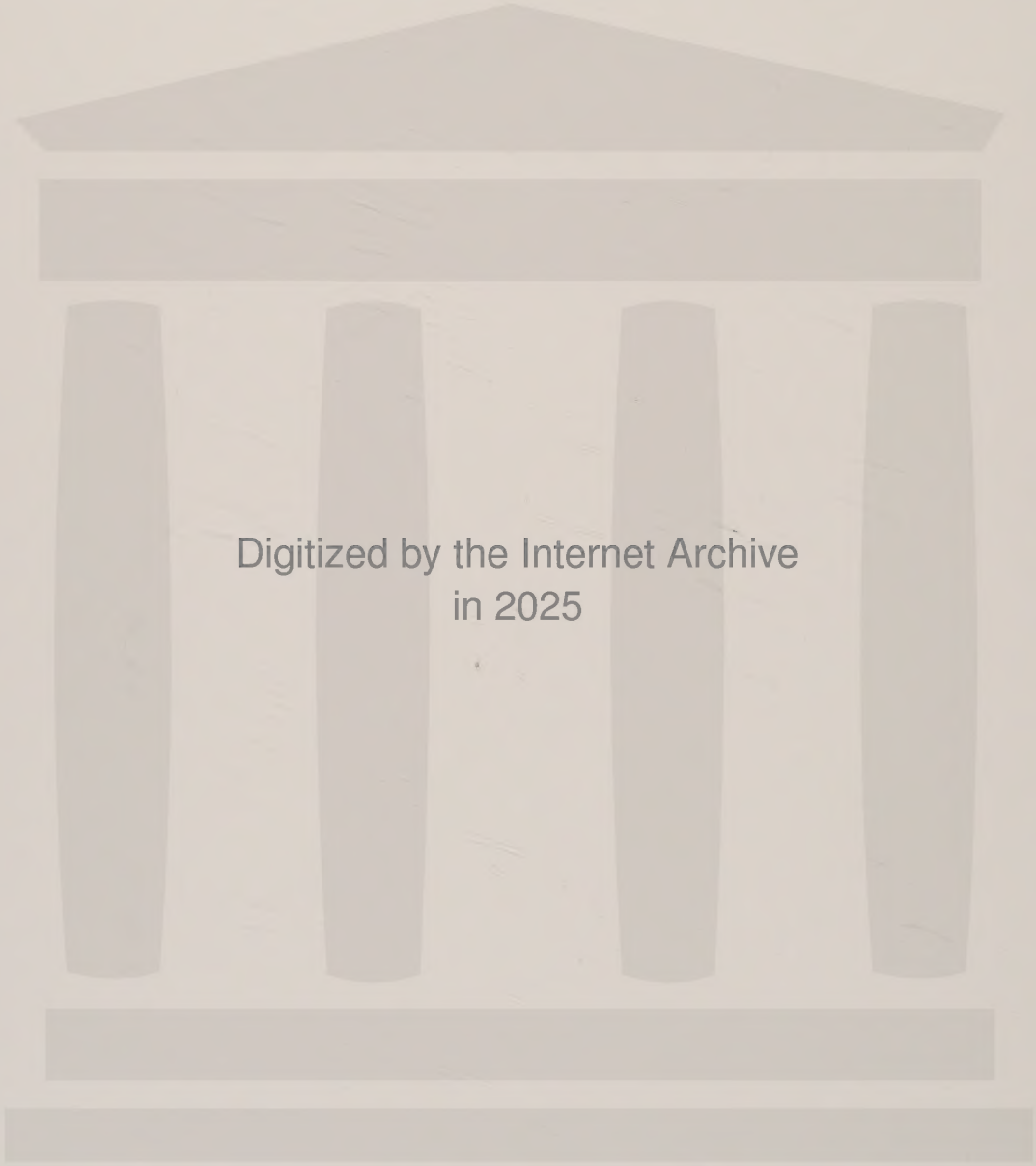
Amateur Net Fishing Survey of Two Western Australian South Coast Estuaries in January 1981

BY

D. I. HEALD

PERTH
WESTERN AUSTRALIA

1984


Digitized by the Internet Archive
in 2025

https://archive.org/details/wa-fisheries-research-reports_1984_60

Department of Fisheries and Wildife

108 Adelaide Terrace

PERTH

REPORT
No. 60

AMATEUR NET FISHING SURVEY OF TWO WESTERN AUSTRALIAN SOUTH COAST ESTUARIES IN JANUARY 1981

BY

D.I. HEALD

1984

ISBN 0 7244 9309 3

ISSN 0726-0733

32021—1

CONTENTS

		PAGE
	ABSTRACT	9
I	INTRODUCTION	9
II	DESCRIPTION OF SURVEY AREAS	11
	(a) WELLSTEAD ESTUARY	11
	(b) BEAUFORT INLET	11
III	METHODS	12
	(a) FIELD INFORMATION	12
	(b) LABORATORY METHODS AND ANALYSES	13
IV	RESULTS	14
	1. NET FISHING INTENSITY	14
	(a) WELLSTEAD ESTUARY	14
	(b) BEAUFORT INLET	15
	2. SPECIES COMPOSITION AND QUANTITIES CAUGHT	15
	(a) WELLSTEAD ESTUARY	15
	(b) BEAUFORT INLET	16
	3. THE RELATIONSHIP BETWEEN THE MESH SIZE USED, CATCH RATES AND SPECIES SIZE COMPOSITION.	17
	(a) SEA MULLET	17
	(b) SIX-SPINED LEATHERJACKET	17
	(c) YELLOW-EYE MULLET	17
	(d) BLACK BREAM	18
	(e) AUSTRALIAN HERRING	18
	(f) COBBLER	18
	4. LENGTH-WEIGHT RELATIONSHIPS	19
	5. SUCCESS RATE	19
	6. OPINIONS ABOUT FISHING IN THE TWO ESTUARIES	19

CONTENTS (CONT'D)

		PAGE
V	DISCUSSION AND CONCLUSIONS	19
	A. USAGE	19
	B. CATCHES OF DIFFERENT SPECIES	20
	C. FISHING PRACTICES	21
	D. POSSIBLE SOURCES OF BIAS	22
VI	RECOMMENDATIONS	22
	(a) WELLSTEAD ESTUARY	22
	(b) BEAUFORT INLET	23
VII	ACKNOWLEDGEMENTS	23
VIII	REFERENCES	24

TABLES

		Page
1.	Frequency of gill net sets by fishing parties in Wellstead estuary and Beaufort Inlet from 5-30 January, 1981.	25
2.	The number of sets by mesh size (mm) at sites in (a) Wellstead estuary (BR) and at (b) Beaufort Inlet (PA) in January 1981. The cumulative % figures for use of net meshes below the legal minimum 76 mm and above this size are also shown.	26
3.	Relative abundance and mean weight of fish and crustacea caught by set nets at Wellstead estuary and Beaufort Inlet irrespective of mesh size used. Edible species are marked by asterisk.	27
4.	Daily net fishing in Wellstead estuary, January 1981.	28
5.	Daily net fishing in Beaufort Inlet, January 1981.	29
6.	A comparison of the catches and catch rates of sea mullet by 30 m monofilament nets from day sets at two lightly fished sites in Beaufort Inlet, January 1981.	30
7.	Mean catch rates (No. per overnight set) of fish and crabs caught by different sized mesh in Wellstead estuary, January 1981. Brackets denote catch from a single set.	31
8.	Mean catch rates (No. per overnight set) by different sized mesh used in the Beaufort Inlet, January 1981. Brackets denote catch from a single set.	32
9.	Size composition, mean length and standard deviation (S) of sea mullet caught by set nets of different mesh size in Wellstead estuary (BR) and Beaufort Inlet (PA), January 1981.	33
10.	Size composition, mean length and standard deviation (S) of six-spined leatherjacket caught by set nets of different mesh size in Wellstead estuary (BR), January 1981.	34
11.	Size composition, mean length and standard deviation (S) of yellow-eye mullet caught by set nets of different mesh size in Wellstead estuary (BR) and Beaufort Inlet (PA), January 1981.	35
12.	Size composition, mean length and standard deviation (S) of black bream caught by set nets of different mesh size in Wellstead estuary (BR) and Beaufort Inlet (PA), January 1981.	36

TABLES (continued)

Page

13. Size composition, mean length and standard deviation (S) of Australian herring caught by set nets of different mesh size in Wellstead estuary (BR), January 1981. 37

14. Size composition, mean length and standard deviation (S) of cobbler caught by set nets of different mesh size in Wellstead estuary (BR) and Beaufort Inlet (PA), January 1981. 38

15. Length-weight relationships for important fish species caught by set net in (a) Wellstead estuary and (b) Beaufort Inlet in January 1981. 39

16. How actual catches of fish and crabs from set nets measured up to expectation of amateur fishermen in (a) Wellstead estuary and (b) Beaufort Inlet in January 1981. 40

FIGURES

Page

1. Wellstead estuary and Bremer River, showing net fishing sites and the relationship of this system to other south coast estuaries. 41

2. Beaufort Inlet and Pallinup River, showing net fishing sites and the relationship of this system to other south coast estuaries. 42

3. The number and status of net fishing parties amongst those parties interviewed from (a) Wellstead estuary and (b) Beaufort Inlet during the January 1981 survey. 43

4. Distribution of fishing effort in respect of mesh size. 44

5. Coastal features of Beaufort Inlet and part of the Pallinup River, for which a closure to net fishing is proposed. 45

6. Catch rates of edible fish in Wellstead estuary, January 1981, plotted as mean ■ and range I for three day intervals. The number of samples is shown at the maximum point. 46

7. Catch rates of edible fish in Beaufort Inlet, January 1981, plotted as mean ■ and range I for three day intervals. The number of samples is shown at the maximum point. 47

8. Length composition of the total measured catch of selected species of fish taken in all sizes of mesh combined from Wellstead estuary (BR [redacted]) and Beaufort Inlet (PA [redacted]). MLS is minimum legal size; the MLS for cobbler was estimated from an equation relating fin length to total length. 48

9. Coastal features of the Bremer Bay area, showing access roads and part of the Bremer River closed to net fishing. 49

PLATES

		Page
1.	Panorama of Wellstead estuary, from Lookout Hill, taken in April 1981. Water level was very low. The barrier sandbar is at right and Bog Arm is at left (see Fig. 1 also)	50
2.	View of Wellstead estuary, late one afternoon in January 1981, looking up the estuary towards site 32.	51
3.	A fishing party at Beaufort Inlet hauling in a set net from the southern end of site 18, near the barrier sandbar.	51
4.	A view of Swallow Cave Pallinup River from the opposite shore looking downriver.	52
5.	An above average catch from an amateur net set in Wellstead estuary, January 1981.	52
6.	*Mugil cephalus*, the sea mullet	53
7.	*Meuschenia freycineti*, the six-spined leatherjacket.	53
8.	*Aldrichetta forsteri*, the yellow-eye mullet.	54
9.	*Acanthopagrus butcheri*, the black bream.	54

APPENDICES

		Page
1.	Shire of Gnowangerup by-laws relating to fishing which were in effect between 1938 and October 3, 1980.	55
2.	Details of the opening and closure to the sea of Wellstead estuary from all available records.	59
3.	Surface salinity samples taken from Wellstead estuary and Bremer River in January, 1981.	60
4.	Surface salinity samples taken from Beaufort Inlet and Pallinup River in January, 1981.	61
5.	The letter of introduction given to the fishing public in the areas dealt with by the survey.	62
6.	Fish catches reported by different fishing parties mainly using 76 mm mesh set nets since 1 August, 1981 in Wellstead estuary.	63

Dept. Fish. Wildl. West. Aust. Rept No. 60 1984, 1-63

AMATEUR NET FISHING SURVEY OF TWO WESTERN AUSTRALIAN SOUTH COAST ESTUARIES IN JANUARY 1981.

David I. Heald
Western Australian Marine Research Laboratories
P.O. Box 20, North Beach, Western Australia 6020.

ABSTRACT

Following the return of the administration of fishing activities in Wellstead estuary and Beaufort Inlet to the Western Australian Government in October 1980, a survey of the amateur net fishing in these two estuaries was undertaken in January 1981. The purpose of the survey was to document usage, species catches and size composition of fish caught in respect of mesh size used and the success rate of amateur net fishermen as compared to their expectation. At the time of the survey, Wellstead estuary had been closed to the sea for 13 months and Beaufort Inlet for 27 months and the respective surface salinities in each estuary were 54‰ - 63‰ and 45‰ - 46‰ . Out of a total of 443 parties met at Wellstead estuary during survey, 6% used set nets whilst out of 33 parties met at Beaufort Inlet, 73% used set nets. 76 mm mesh nets (the minimum legal size mesh permitted for these estuaries) was most popular in each area within the 57-114 mm range of meshes being used. The total number of sets during the survey was about the same in each estuary. Net fishermen achieved a mean catch rate of 8 fish per overnight set in Wellstead estuary and 20 fish per set in Beaufort Inlet. The legal mesh which achieved the highest mean catch rate of fish was 76 mm for Wellstead estuary and 83 mm for Beaufort Inlet. Dominant species in set net catches were sea mullet (36%) and six-spined leatherjacket (33%) in Wellstead estuary compared with mainly sea mullet (84%) in Beaufort Inlet where catches equalled or exceeded expectation on 66% of sets compared to Wellstead estuary where only 37% of catches satisfied the fishermen. Catch data gathered in Wellstead estuary in 1981 after winter rains revealed that fish catch rates had trebled and the species composition was 58% sea mullet and 33% black bream in the estuary whereas later (after the estuary broke to the sea in January 1982) the fish catch rate was twice the January 1981 level and the species composition had again altered to 54% black bream and 27% sea mullet.

I INTRODUCTION

Since 1938, the Gnowangerup Shire Council had control of the fishing activity in Wellstead estuary (Bremer River) and Beaufort Inlet (Pallinup River) through the administration of a set of by-laws relating to set net fishing, the most recent version of which is presented in Appendix I. As outlined in by-law 10, the holder of a current Shire licence was permitted to set a lawful

net defined as one no longer than 64 m (70 yards) with a minimum mesh size of 76 mm (3"). A recommendation that the control of fishing in these two river systems revert to the State Government, under the administration of the Department of Fisheries and Wildlife was made after a tour in 1973 by the South West Parliamentary Study Committee (Hassell et al. 1974). The recommendation which followed resulted in a decision by Government to amend both the Local Government Act and the Fisheries Act to enable responsibility for management of Beaufort Inlet and Wellstead estuary to be transferred to the Department of Fisheries and Wildlife.

In practical terms, changes to the fishing regulations now defined a lawful net as having a length of not more than 60 m and meshes of not less than 76 mm for Wellstead estuary and Beaufort Inlet downstream from the southern boundary of Reserve 817. Upstream from the latter, a previous regulation which stated that a lawful net could be no longer than 137 m (150 yds) with a mesh size of not less than 70 mm (2 5/8") was cancelled by Notice 25, Government Gazette No. 7, 25 January 1980 which therefore made a lawful net 60 m, with a mesh of no less than 76 mm in all waters of Beaufort Inlet, Walpup River and their tributaries. A second notice imposed a permanent closure to net fishing in the Bremer River upstream of the Narrows (see Figure 1). Except for a slight reduction in net length, both of these amendments to the Fisheries Act perpetuated previously existing State regulations. By virtue of the restriction of net length professional fishermen can only operate legally in either estuary or its river system using a single 60 m net per licence.

In 1980, it was decided that a survey of set net fishing in Wellstead estuary and Beaufort Inlet was required to evaluate the current status of net fishing in these areas. The survey objectives were to determine:

1. The number of fishermen operating (fishing intensity).

2. The species and quantity of fish caught.

3. The size composition of fish caught in the different mesh sizes being used.

4. The success rate as compared to the expectation of amateur net fishermen.

This survey was planned to coincide with the period of peak recreational usage of these areas by fishermen and holiday makers and accordingly was conducted in January 1981 (Caputi and Lenanton, 1981). For the purposes of this report the phrase 'Wellstead estuary' pertains only to the estuary proper (i.e. no further up the Bremer River than the Narrows, Figure 1)

whereas the phrase 'Beaufort Inlet' pertains to all waters in the Pallinup River down river from Swallow Rock (Figure 2) except for salinity data.

II DESCRIPTION OF THE SURVEY AREAS

(a) Wellstead estuary

Wellstead estuary (Plates 1 and 2, Figure 2) is quite small (340 ha) compared with others in Western Australia and was relatively shallow in January 1981 (ca. 0.6 m, apart from a narrow 1.5 m deep channel near the mouth (Figure 1). Lenanton (1974a) classified Wellstead estuary as a normally closed system which it was in January. Departmental records show that the average duration of closure is 2 years 8 months (range 2-6½ months) and that it is open to the sea for an average of 13 months (range 1-23 months, Dr E.P. Hodgkin, pers. comm.). Prior to the survey the bar opened in July 1978 and remained open to the sea for 15 months (Appendix 2). The barrier sandbar across the estuary mouth was ca. 1 m above sea level and the physical environment of the sheltered mouth is considered to be a low energy situation (R. Lenanton, pers. comm.). After heavy rain in the district, the flush of water which followed opened the bar on January 27, 1982 (Appendix 2). Runoff into the river is from a relatively small catchment area and is usually irregular and rather low. Thus evaporation regularly exceeds freshwater input. When the bar is closed this produces a hypersaline environment (Appendix 3) over the summer accompanied by a falling water level. When compared with other surface salinity data collected in Wellstead estuary, the values encountered on this survey viz. 54‰ to 67‰, mean 59.6‰ seemed exceptionally high, in fact some 20‰ higher than ever previously recorded (Lenanton pers comm.). The water was quite turbid upstream but became clear in the estuary. It is likely that the clear estuarine water resulted from enhanced precipitation of solids in the higher salinity regions of the system (Eckwald and O'Melia, 1975; also see Appendix 3 of this report).
Extensive meadows of filamentous algae and seagrass occur over vast areas of the estuary.

Colonies of the tube worm, *Mercierella enigmatica* occurred in clumps which formed mounds throughout the estuary and the mussel *Mytilus edulis* was found in the vicinity of the Narrows shores.

(b) Beaufort Inlet

Despite having a greater surface area (ca. 470 ha) than Wellstead estuary, Beaufort Inlet (Plate 3, Figure 2) is also small in comparison with others in W.A. It was deeper than Wellstead estuary in January and like the Wellstead estuary varies in depth according to the respective rates of seasonal runoff and evaporation. Local residents state that it is more than 3 m deep in parts. Lenanton (1974a) described this system also as normally closed which it was in January, 1981. On the most recent

opening prior to the survey, its barrier sandbar was cut by the rising river in July 1978 and remained open to the sea for 10 weeks. Since that closure, floodwaters broke the bar on 23 January 1982, and it closed again on 10 September, 1982. Other complete and precise records of its opening and closing are unavailable, but local knowledge suggests that it breaks through about once every 3-4 years, and remains open to the sea for a few weeks to a few months. Despite the larger catchment area, a much larger runoff and river flow is needed to cut through the 0.4 km long sandbar which has an approximate height of 3 m above sea level. The physical environment of the oceanic side of the bar is a high energy situation (Lenanton, pers. comm.). A hypersaline environment usually exists in the estuary in the summer (Appendix 4). The surface salinity readings found at Beaufort Inlet during this survey, downriver from Yate Rocks (Figure 2) viz.45-46‰ were within the range of values found on previous sampling occasions (Lenanton pers.comm.). When the system was closed in the past, high summer evaporation has sometimes contributed to the deaths of large numbers of fish (e.g. 1953, Department of Fisheries and Wildlife records*). Generally, these mortalities have been preceded by a deterioration in fish condition (ulcers, fish swimming at surface with mouths gaping) due no doubt to the combined effects of high salinity and the low dissolved oxygen level of the estuary water. In this regard it is interesting to note that Pallinup was formerly called Salt River.

During the survey, the water level fell 0.3 m and its colour was a uniform translucent brown.

Filamentous algae and seagrass beds predominated in areas such as Mullet Bay (Figure 2), but did not hamper boat passage through the estuary or up river. Abundant colonies of the tube worm, *Mercierella enigmatica* were encountered throughout this river system at, and below, water level along the shore line and on sunken branches.

III METHODS

(a) Field information

About 2 weeks were spent in each area, interviewing set net fishermen and sampling their catches. The first and third weeks were at Wellstead estuary and the second and fourth weeks were at Beaufort Inlet. During the weeks in residence at each estuary, it was believed that all catches were sampled daily. However, during the periods of absence from an estuary, the only catch data collected from there were by those parties who volunteered to keep records for me. To meet as many parties as possible, extensive use was made of the Bremer Bay Caravan Park Holiday Register as well as regular visits to campers, caravaners and lodgers both in Bremer Bay and around Beaufort Inlet. At the

*File 801/74

beginning of each interview, a letter of introduction, explaining the objectives of the survey (Appendix 5) was presented to net fishermen. Then the following information was requested from each party:

(a) The number of net fishermen in the party.

(b) The number of nets intended for use by each party.

(c) The specifications of each net viz. mesh size (mm) length (m) construction (mono- or multifilament) and the depth (m).

(d) The catch expectation (number or weight of fish)

When net fishermen were intercepted whilst in the process of pulling their nets the following additional information was sought:

(e) The fishing location in order that the information supplied be assigned to one of the arbitrary research areas (Figs 1 and 2).

(f) The time at which the net was set and its fishing duration.

(g) The number of each species of fish or crustacean caught.

(h) The lengths (total length and length to caudal fork, cm) of each species taken in each net and individual weights (gm) of fish comprising a stratified sub-sample.

(i) How the fisherman's realized catch compared to his expectation.

(j) Any known event during the fishing operation which may have reduced the efficiency of the net.

(k) Records of environmental parameters such as salinity, surface water temperature at the fishing site, water turbidity, wind strength and direction, rainfall, cloud cover, moon phase and river flow, and when time permitted,

(l) Additional biological records such as sex, stomach contents and parasites.

(b) Laboratory methods and analyses

The data were transcribed from rough field sheets on to estuarine data coding sheets which standardize data recording and facilitate punching on computer cards (Loneragan and Caputi, pers.comm.). The data were stored on magnetic tape and processed by computer using S.P.S.S.*

*Statistical Package for the Social Sciences

Use of the word 'fish' for Wellstead estuary may include blue manna crabs. Set nets are defined as gillnets which are left in a set position to fish for a given period. It should be noted that data from 60 m nets set overnight was used to calculate the catch rates of amateur nets except for Table 6 which compares catches of 30 m nets from daylight sets. In Table 3, % edible fish is calculated as the proportion of the total edible fish (those marked by asterisk) from the total number counted for all species combined. A high proportion of fish counted for each species was also measured.

Staff at the W.A. Museum assisted with identification of the fish species and their dietary items.

IV RESULTS

1. Net fishing intensity

(a) Wellstead estuary

The number and status of holidaying parties encountered each estuary is presented in Figure 3. Of the 443 par met at Wellstead estuary, tourists outnumbered residen by 48:1. There were 29 parties (6% of those met) who set nets in the estuary from 3-29 January, 27 of which tourist and 2 were local residents. Net fishing parti had 1-3 nets with them which they usually set once or twice (range 1-26, averaging 3.1 times) during their stay (Table 1). The distribution in Table 1 is positively skewed by the fishing activity of a single party which set a net 26 times. If this is excluded fro the calculations, an average of 2.3 sets per party-sta obtained is probably a better estimate of net fishing intensity. The distribution of fishing effort by mesh size for Wellstead estuary is compared with that of Beaufort Inlet in Figure 4. Table 2 shows usage of different mesh sizes at the various sites in each estuarine system and the proportion of nets with undersized mesh. In Wellstead estuary, net fishing wa concentrated at sites 17 (29%), 15 (22%) and 12 (18%) (Figure 1). 85% of fishermen used nets of 76 mm mesh or larger and 15% used undersized mesh (Table 2).

As foreshore access was not a problem at Wellstead estuary, a vehicle was used extensively each afternoon to watch fishing activity from vantage points and intercept parties returning from setting their nets. Following greetings and the handing out of the letter of introduction, (Appendix 5) an arrangemen to sample the catch on the following morning was made which was least disruptive to the net owner. On days when only a few nets were set, it was often possible to collect all the information required but on busy days when dinghies were landing simultaneously at different places, only a count by species was possible.

In addition, in order to maximise measurements an arrangement was made for those fishermen who were not in a hurry, to soak their catch so that others who may have required the fish for an early breakfast could be dealt with first.

(b) Beaufort Inlet

33 parties were interviewed at Beaufort Inlet of which 31 were tourist and 2 were resident (Figure 3). Of those interviewed, 24 parties (73%) had brought set nets to use in the Beaufort Inlet from 11-30 January, 1981. Thus 22 of the 31 tourist parties (71%), and both resident parties netted during that time. Fishing parties had between 1-3 nets with them (average, 1.3) which they usually set 2 or 3 times (range 1-11 average 3.3 times) during their stay (Table 1). The net fishing intensity here was also positively skewed due to the efforts of a few keen net fishermen. Most net fishing was undertaken at site 25 (22% of sets) and site 12 (13% of sets) (Table 2 and Figure 2). The distribution of fishing effort by mesh size in Beaufort Inlet is compared with that in Wellstead estuary in Figure 4. Similar regimes existed in each system. The preferred mesh size used was 76 mm (63%) and the second most popular was 83 mm (16%). 88% of mesh used was of legal size and 12% was undersized. No samples were obtained upriver from Reserve 817 at Swallow Cave (Figures 2,5, Plate 4) because the river was impassable at that time.

Due to a lack of good access roads around Beaufort Inlet, an outboard motor powered dinghy was found to be the most effective means of covering the estuary and river for sampling purposes. Late each afternoon, a boat tour revealed parties setting nets all of whom were happy to provide data for the survey.

2. Species composition and quantities caught

(a) Wellstead estuary

On the basis of catches sampled irrespective of mesh size used, the relative numbers of species sampled are presented in Table 3. Sea mullet (36%) and the six-spined leatherjacket (33%) were the dominant edible fish species in Wellstead estuary during the survey. A total of 731 edible fish were counted in set net catches at Wellstead estuary (Table 4), or 225 kg of biomass based on mean weights from Table 3. The figures are equivalent to an average catch rate of 8 fish per overnight set (2.5 kg whole weight). An above average catch is shown in Plate 5.

Catches varied from 0-58 fish per set but it should be noted that the number of sets was underestimated for the periods 12-19 January and 27-29 January during the officer's absence from this estuary. To detect any

trend which may have been present, the mean and range of individual catch rates over consecutive 3 day intervals were plotted in Figure 6. Maximum catch rates were higher, earlier in the month but there was no significant trend in mean catch rate. The depressed mean catch rate about 20 January may have resulted from increased avoidance of the nets during the night by the fish in clear estuarine water during this period of full moon.

Winter freshwater inflow into the estuary considerably raised the water level. The average catch rate in late winter had improved to 26 fish per set from data supplied by a local fisherman (Appendix 6) although this was not necessarily related to the inflow.

Beaufort Inlet

Sea mullet dominated catches in this estuary and comprised 84% of fish counted. They were more numerous in catches from Beaufort Inlet than they were in Wellstead estuary catches. Six-spined leatherjackets and blue manna crabs were absent from catches (Table 3). A total of 1616 edible fish were caught (Table 5) which was equivalent to a removed biomass of 572 kg of fish based on mean weights (Table 3). The average overnight catch rate was 20 edible fish per set (7.2 kg). Catches ranged from 1 to 104 fish per set (Table 5). Catch rate data, grouped into 3 day consecutive intervals showed that not only the means but also the maximums (Figure 7) were higher than at Wellstead. Swallow Cave (site 31, Figure 2) yielded the highest catch of any site viz. 104 fish/set. As the Pallinup River is only about 50-70 m wide here, it can be subject to unfair fishing practice such as 2 nets being operated close together and with power boats or beating techniques many fish can be driven into nets. Although the nets may be of legal mesh size and distance apart (50 m) such a practice can effectively trap most of the fish of vulnerable capture size from that tract of river using these methods. It is not known how widespread this particular practice is nor how often it is repeated but one thing is certain - the letter of the law is upheld whilst its spirit is defeated. Thus fish stocks here are more vulnerable to capture and more susceptible to localized depletion by amateur nets than in wider parts of the river or the estuary. It is difficult to compare the efficiency of different sized mesh in catching black bream because there were too few sets in most mesh size categories.

Daylight catch rates by 76 mm monofilament nets have been compared at two lightly fished sites in Beaufort Inlet (Table 6). Calculated catch rates of 10-72 fish per hour demonstrated the effectiveness of this combination in the murky water conditions there.

3. The relationship between mesh size used, catch rates and species size composition.

Tables 7 and 8 compare mean catch rates of species for different mesh sizes used in Wellstead estuary and Beaufort Inlet respectively. The size composition of the more important edible species caught by amateur fishermen in the various mesh sizes used in each estuary is presented in Tables 9-14. Length frequency data from all mesh categories combined have been presented in Figure 8.

Important edible species are discussed separately below.

(a) Sea mullet *Mugil cephalus* Linn., 1758 (Plate 6, Tables 7,8,9, Figure 8). Overall, the modal size of fish at Wellstead estuary (34 cm T.L.) was greater than that from the Pallinup river system (31 cm T.L.). For a given mesh size, the modal size of sea mullet caught at Wellstead was greater than at Beaufort Inlet. No mesh size used caught undersized fish. The relative efficiency of the different sized mesh is apparent from a comparison of mesh usage with proportion of fish caught (Table 9).

A comparison of catch rates of this species by legal mesh size in Wellstead estuary (Table 7) revealed that 76 mm mesh caught sea mullet most efficiently whereas 83 mm mesh caught at less than half the rate of 76 mm mesh. Of the undersized mesh used, 63 mm caught 5 times as many sea mullet as 76 mm mesh. In Beaufort Inlet 83 mm mesh was the most efficient and 76 mm mesh was second (Table 8) amongst the legal sized meshes used. In the catches from undersized mesh, 63 mm and 70 mm both caught sea mullet at better rates than 76 mm mesh. Mesh of 102 mm and above did not catch sea mullet in either estuary. The mean size of fish caught increased slightly with mesh size in Wellstead estuary with a less obvious trend in fish from Beaufort Inlet. Sea mullet were feeding mostly on weed and the tiny gastropod *Hydrococcus brazieri*. These results are based on the measurement of 95% of sea mullet counted at Wellstead and 46% of those counted from Beaufort Inlet catches.

(b) Six-spined leatherjacket *Meuschenia freycineti* (Günther), 1870 (Plate 7, Tables 7, 10, Figure 8). This species was present only in Wellstead catches. The overall modal size of six-spined leatherjacket was 25 cm T.L. Larger sized mesh caught proportionately more fish than smaller mesh, e.g. 83 mm mesh was more efficient than 76 mm mesh (Table 7) possibly because the fish is deep bodied. All mesh sizes caught undersized fish. There was no obvious relationship between mean fish size caught and mesh size used. 96% of fish counted were measured.

(c) Yellow-eye mullet *Aldrichetta forsteri* (Cuv. et Val.) 1846 , (Plate 8, Tables 7,8,11). Even though smaller numbers were caught, Figure 8 and Table 11 show that those fish in Wellstead estuary were larger (mode 31

cm T.L.) than those at Beaufort Inlet (mode 28 cm T.L.). Only 1 fish caught was below the minimum legal size (Table 11). In both areas, the numbers of fish caught decreased with increasing mesh size (Tables 7,8) e.g. in Wellstead 63 mm mesh used on 13% of occasions caught 56% of fish sampled whereas 76 mm mesh (55% usage) caught 40% of fish sampled. Nets of 83 mm or larger mesh did not capture the size range of yellow-eye mullet present at the time as effectively as the smaller meshes. Yellow-eye mullet were mainly feeding on sea grasses containing *Hydrococcus brazieri* and *Mercierella enigmatica*. Many of the yellow-eye mullet measured appeared to be in poor condition, possibly due to their exposure to salinities up to 65‰. The fish affected were coated in a heavy secreted slime and fin rays were ragged edged, which may have been in response to high salinity. Fish measured exceeded 90% of those counted in each estuary.

(d) Black bream *Acanthopagrus butcheri* Munro, 1949 (Plate 9,Tables 7,8,12, Figure 8). Overall, fish caught in Wellstead estuary tended to be undersized whilst a greater proportion of those caught in Beaufort Inlet tended to be legal sized (Figure 8, Table 12). In the latter area there were distinct modes at 22 cm and 29 cm. This bimodal distribution was effectively partitioned by the minimum legal size of 25 cm (Table 12). Black bream stomachs contained *Mercierella enigmatica*, mudskippers,the southern anchovy and the tiny gastropod *H. brazieri*. In each area, the most effective mesh size used was 102 mm. Of the fish counted the proportions which were also measured were 100% at Wellstead and 94% at Beaufort Inlet.

(e) Australian herring *Arripis georgianus* (Cuv. et Val), 1831 (Tables 7,13, Figure 8). All fish caught were of legal size (Figure 8). The modal size was 24-25 cm T.L. There was no trend shown between mean fish size and mesh sized used, however it was obvious that smaller mesh captured fish just as effectively as larger mesh (Table 7). 84% of fish counted were measured.

(f) Cobbler *Cnidoglanis macrocephalus* (Cuv. et Val), 1840 (Tables 7,8,14, Figure 8.) Two distinct size classes of cobbler were present in Wellstead estuary catches, 42 cm T.L. and larger adults >50 cm T.L. (Table 14). The presence of juveniles and large adults in Wellstead estuary suggests that breeding within the system has probably occurred since November 1979 when the bar closed. The total measured catch was too few for a clear mode to be seen. In contrast to Wellstead estuary, fish from the Beaufort Inlet system were medium sized with a distinct mode at 46 cm T.L. In legal sized mesh some fish were caught in 76 mm net but the most efficient mesh size was the undersized mesh 63 mm in Wellstead estuary and 70 mm

in Beaufort Inlet. Cobbler stomachs contained mostly algae and polychaete worms. All fish counted at Wellstead were also measured and 97% of fish counted at Beaufort Inlet were measured.

Insufficient numbers of King George whiting and silver bream were caught to warrant statistical treatment.

4. Length-weight relationships

Relationships were calculated for total length with total weight of edible species for which there were sufficient numbers and are presented in Table 15. Sampling of fish weights was stratified to enable a good fit for the equation across the entire length range sampled.

5. Success rate

During the survey, it became obvious that a fishing party rarely had an exact idea of how many fish per set it expected to catch, therefore the actual amount to serve as a baseline expectation was expressed in dozens. Although there was some variation among fishing parties, the average expectation for both Wellstead estuary and Beaufort Inlet was 1-2 dozen fish. In addition it should be noted that the catch expectation was often reduced at Wellstead estuary after a poor catch was taken from the first set. Thus the expectation is not necessarily constant among parties or for one party during its stay. Table 16 compares actual catches with a party's expectations in (a) Wellstead estuary and (b) Beaufort Inlet. Each result was classified either as catch above expectation, catch equal with expectation, or catch below expectation.

At Wellstead estuary 60% of catches were below expectation, 28% equalled the expectation, 9% were above and 3% could not be classified because the catch was from a first ever set. In the Beaufort Inlet parties caught less than their expectation on 29% of sets, catch equalled expectation on 35% of sets and catch exceeded expectations on 31% of sets. Thus 66% of sets yielded favourable catches in Beaufort Inlet compared with 37% at Wellstead estuary. Except for a common desire to catch some black bream, preference to catch a particular species was seldom expressed.

6. Opinions about fishing in the two estuaries

During interviews, many opinions concerning fishing in Wellstead estuary and the Beaufort Inlet were offered. These have been summarised and placed on file with the Department of Fisheries and Wildlife.

V DISCUSSION AND CONCLUSIONS

A. Usage

Only 6% of the total number of parties encountered in Wellstead estuary set nets. In contrast, a high proportion

73% of parties set nets at Beaufort Inlet which confirmed that net fishing was the most popular recreation activity undertaken there. Fishing intensity (number of sets in the survey period) was about the same in both areas. The majority of parties met were tourists (Figure 3).

Fishing parties usually set their nets once to twice at Wellstead estuary but twice to three times at Beaufort Inlet depending somewhat on how long they stayed in the area.

The distribution of mesh sizes used revealed that 76 mm was most often used in both areas and therefore the most popular mesh size (Table 2). Next most popular mesh size was 83 mm. Combined data on netting from both areas has shown that 87% of nets set were of legal size (76 mm - 114 mm) and 13% were below legal size mesh (57 mm - 70 mm). Use of illegal mesh was about the same frequency in each area (Table 2).

B. Catches of different species

From Table 2 and Figure 4, it is apparent that the usage frequency of different mesh sizes was essentially similar for the two estuaries over the period of the survey. There was generally little difference in gear selectivity and fishing effort on the species caught. Other factors such as differences in water clarity and salinity were therefore considered. Differences were found in:

(i) species diversity - there was a higher diversity in Wellstead estuary (16 species) compared with Beaufort Inlet (7 species);

(ii) size composition (see Figure 8);

(iii) catch rates.

The total numbers of fish counted from each system for species marked (†) in Table 3 should be compared. The different counts may reflect real differences in abundance of fish populations in the two systems, probably as a result of recruitment from the sea and are most likely related to the recent environmental history of each system. The history is manifest in the seasonal timing, duration and interval between consecutive openings of the bars (Appendix 2) in relation to the availability of recruits from the ocean.

In the above comparison of numbers of fish caught in each system, black bream was deliberately excluded. This was because the mean length of black bream taken by 76 mm mesh (the only mesh size set frequently enough to allow appropriate comparison) was significantly larger in Beaufort Inlet (27.2 cm) than the mean length of black bream captured in Wellstead estuary. Differences in the distribution of those mesh sizes which effectively caught black bream did not allow an unbiased comparison between the systems of the numbers of black bream caught.

In Wellstead estuary, the predominance of marine species such as six-spined leatherjacket, Australian herring and to a lesser extent King George whiting probably reflects the longer interval of 16 months for which Wellstead estuary remained open to the sea and that in turn is governed largely by the more sheltered location of the estuary mouth.

Re-stocking by species other than black bream, which breeds and lives strictly within the estuary, is clearly dependent on a breach of the barrier sandbar. When this happens, most of the large mullet are able to leave the estuaries and small 0+ fish may migrate into the systems. The success of re-stocking is not apparent until the new recruits reach catchable size again. During this period, set net catches can be severely reduced if larger fish do not remain in or re-enter the system during the opening.

Illegal use of undersized 63 mm mesh in Wellstead estuary gave the fisherman a significant advantage over the user of legal sized (76 mm+) mesh i.e. 5x the catch rate of sea mullet and yellow-eye mullet. At Beaufort Inlet, the undersized mesh of 63 mm and 70 mm yielded catch rates well above that of 76 mm nets for sea mullet, whilst 57 mm nets showed a 6x increase in their catch rates of yellow-eye mullet.

The fishing success rate as a function of catch expectation (Table 16) was compared for each estuary. At Beaufort Inlet, twice as many sets yielded a favourable result as those at Wellstead estuary. Under regimes of approximately equal fishing intensity, it has been suggested above that fish in Beaufort Inlet were in greater abundance at least during the survey period.

C. Fishing Practices

Net fishing in Beaufort Inlet has been the historic custom of farmers and residents of nearby centres as well as some tourists for many years. Thus any increase in fishing effort on the fish stocks here may reduce their catch expectation.

Bremer Bay is now one of the most popular holiday resorts in the State, renowned for its net and line fishing even though the former activity was indulged in by only 6% of parties interviewed. The monetary value of the fish resource appears to be secondary to the pleasure derived by this group in pursuing their chosen leisure activity, usually over the summer holiday period. Bearing in mind the pressures of modern work life and the increasing desire for people to "get away from it all" and "do their own thing" on their holidays, this area provides immense value both to the amateur fishermen and other people who use it. It was also apparent that, in terms of the size of the area being fished and the availability

of fish at that time, the level of usage found at Wellstead estuary exerted a moderate pressure on some species and a significant pressure on others over the summer period. Whilst winter catch rates indicated that a depletion of fish stocks did not occur (Appendix 6), the importance of the closed area up river of the Narrows should not be underestimated. It serves as a refuge from net fishing for some of the fish during the summer period of extensive netting in the estuary, and not only helps to ensure fish catches in the following tourist season (provided the bar has not been broken in the meantime) but also allows line fishermen to attempt to catch black bream without competition from nets.

D. Possible sources of bias

Those sources of bias which may have affected the estimation of the level of net fishing in each area include:

(a) The possibility that catches missed in one area when the officer was in the other area were not typical of catches examined.

(b) The possibility that fishing operations were also very much greater during such absences.

(c) The likely reduction in fishing effort by resident fishermen during this period due to the presence of the officer and that of tourists.

(d) The exclusion from samples of illegal professional night net fishing operations of short duration which would not have been detected and which are alleged to have occurred once or twice during the survey.

VI RECOMMENDATIONS

Although they are beyond the scope of the strict objectives of this survey I would nevertheless like to make some recommendations:

A. Wellstead estuary

1. That signs be placed at various strategic sites, to familiarize the net fishing public with regulations which apply to net fishing. Those regulations often abused were legal length of net and mesh size and the required distance apart for setting nets.

2. That the ban on net fishing up river of the Narrows (Figure 9) remain in force and that the existing sign be replaced with a Department of Fisheries and Wildlife sign to communicate the condition of the closure.

B. Beaufort Inlet

1. That signs displaying the regulations governing net fishing be placed at strategic sites around the Pallinup system foreshore.

2. That net fishing be banned upriver of Paper Barks Road (Figure 5) to prevent the occurrence of net fishing in this narrower part of the river and to provide fish stocks with a refuge from net fishermen. Black bream, 31% of which were undersized in Beaufort Inlet catches, are seen to be at particular risk. The choice of this position for a closure nevertheless allows part of the river to be fished by nets and access for inspection purposes.

3. To permit professional fishermen to fish here when stocks are threatened with a high mortality when conditions of hypersality and oxygen depletion develop.

VII ACKNOWLEDGEMENTS

I would like to sincerely thank the many people and fishermen who assisted with the measurement of their own catches and willingly provided full information on their fishing activities and in particular Ken and Isobel Burchell for the loan of their vehicle for several days when mine was broken down. Figures 1 and 2 were based on original cartography by the Department of Conservation and Environment supplied by permission of Dr R. Field, based on aerial photographs and reproduced with their permission. Dr F. Wells of the W.A. Museum kindly identified molluscan fauna in fish stomachs and Barry Hutchins identified the leatherjacket species. Mr R. Lenanton, Dr G. Morgan and Dr D.A. Hancock constructively criticized the report and Dr E.P. Hodgkin, Mr and Mrs A. Jury, Mr C. Marsh and Mr B. Wellstead supplied anecdotal and physical information on both estuarine systems. Mr M. Saupin and Miss T. Sellers assisted with preparation of figures, tables and data analysis from computer programs prepared by our statistician Mr N. Caputi.

VIII REFERENCES

Caputi, N.G. and Lenanton, R.C.J. (1977). A survey of the recreational usage of the south coastal estuaries of Western Australia. *Fish. Rept. West. Aust.* 27, 1-41.

Edzwald, J.K. and O'Melia, C.R. (1975). Clay distributions in recent estuarine sediments. *Clay and Clay Minerals* 23, 39-44.

Hassell, W.R.B. et al. (1978). South Coast Fisheries Parliamentary Study Committee Report.

Lenanton, R.C.J. (1974a). Fish and crustacea of the Western Australian south coast rivers and estuaries. *Fish. Bull. West. Aust.* 13, 1-17.

TABLE 1: Frequency of gill net sets by fishing parties in Wellstead estuary and Beaufort Inlet from 5 - 30 January, 1981.

NO. OF SETS	1	2	3	4	6	7	8	9	11	26	TOTAL PARTIES	MEAN NO. SETS
No. Parties setting nets at:												
(a) Wellstead estuary	11	10	1	5				1		1	29	3.1
(b) Beaufort Inlet	4	7	7	2	1	1	1		1		24	3.3
TOTAL	15	17	8	7	1	1	1	1	1	1	53	

TABLE 2. Number of sets by mesh size (mm) at sites in (a) Wellstead estuary (BR) and at (b) Beaufort Inlet (PA) in January 1981. The cumulative % figures for use of net mesh below the legal minimum 76 mm and above this size are also shown.

	(a) Wellstead Estuary							(b) Beaufort Inlet								
MESH SIZE	57	63	76	83	102	COMPOSITE	TOTAL	57	63	70	76	83	89	102	114	TOTAL
AREA	BR	BR	BR	BR	BR	BR		PA	PA	PA	PA	PA	PA	PA	PA	
SITE 11		2	2				4									
12	1		12	1		2	16				2	8				10
13		1					1				4		1	1		6
14		1	3	1	1		6									
15			12	5	3		20				2					2
16											4	4				8
17		5	9	12			26				3					3
18											7					7
25								3			13		1			17
21			2	2			4	1		1	5		1			8
22										1	5				1	7
23											4	1	1	1		7
24									2		1					3
31									1							1
32		3	3				6									
33			6				6									
TOTAL	1	12	49	21	4	2	89	4	3	2	50	13	4	2	1	79
% SETS	1	14	55	24	5	1		5	4	3	63	16	5	3	1	
CUMULATIVE % BELOW (TO LEFT) AND ABOVE (TO RIGHT) LEGAL MESH SIZE	← ILLEGAL MESH		— LEGAL MESH →					← ILLEGAL MESH			— LEGAL MESH →					
	15	14	55	79	84	85		12	7	3	63	79	84	87	88	

TABLE 3. Relative abundance and mean weight of fish and crustacea caught by set nets in Wellstead estuary and Beaufort Inlet irrespective of mesh size used. Edible species are marked by asterisk*.

SCIENTIFIC NAME	COMMON NAME	WELLSTEAD ESTUARY			BEAUFORT INLET		
		TOTAL NUMBER COUNTED	% EDIBLE FISH	MEAN WEIGHT (gm)	TOTAL NUMBER COUNTED	% EDIBLE FISH	MEAN WEIGHT (gm)
Mugil cephalus Linn., 1758	Sea mullet*	267 †	36	377	1282†	84	382
Meuschenia freycineti (Günther), 1870	Six-spined leatherjacket*	242 †	33	243	0†		
Arripis georgianus (Cuv.et Val), 1831	Australian herring*	56 †	8	170	0†		
Acanthopagrus butcheri Munro, 1949	Black bream*	51	7	253	90	6	417
Aldrichetta forsteri (Cuv.et Val.), 1846	Yellow-eye mullet*	51 †	7	308	94†	6	216
Cnidoglanis macrocephalus (Cuv.et Val.), 1840	Cobbler*	24 †	3	666	52†	3	437
Sillaginodes punctatus (Cuv.et Val.), 1829	King George whiting*	14 †	2	164	2†	1	262
Rhabdosargus sarba (Forskal),1775	Tarwhine (Silver bream)*	13	2	242	3	1	305
Portunus pelagicus (Linn.)	Blue manna crab*	10	1	356			
Ammotretis rostratus Günther, 1862	Long snouted flounder*	3	<1				
Scorpis georgianus (Cuv.et Val.),1832	Banded sweep*				1		
Gymnapistes marmoratus (Cuv.et Val.),1829	Devil fish	2		150			
Platycephalus sp.	Flathead*	2	<1	405			
Pseudorhombus jenynsii (Bleeker),1855	Small-toothed flounder*	2	<1	220			
Penaeus latisulcatus Kishinouye, 1900	Western King prawn*	2	<1				
Arripis trutta esper Whitley,1949-50	Australian salmon*	2	<1	420			
Atopomycterus nichthemerus (Cuv.),1818	Globe fish	1					
Usacaranx georgianus (Cuv.et Val.),1883	Trevally*	1	<1				
Engraulis australis fraseri Günther,1868	Southern anchovy				20		
TOTAL		743[1]			1544[2]		

1. Differs from total in Table 4 as this table includes prawns, crabs and some inedible fish species.

2. Differs from total in Table 5 due to losses of fish which were caught in net but dropped out during hauling in.

   Total number of sets Wellstead estuary 89. Beaufort Inlet 79.

3. % edible fish refers to the total count of fish of one species divided by the sum of the counts of all the species classified as edible, expressed as a percentage.

4. Fish counts compared in Discussion part B are marked †.

TABLE 4. Daily net fishing in Wellstead estuary, January 1981.

DATE	NUMBER OF FISH CAUGHT PER SET	EDIBLE SPECIES	SIZES OF MESH USED	NET FISHING PARTIES	NETS SET
050181	2,3	4	76,83	2	2
060181	4	3	76	1	1
070181	7,58,9	9	63,83	3	3
080181	18,26,4,9[C]6,3,17,32[C]	11	63,76,83,102	7	10
090181	5,12,5,13,2,21,3	6	63,76,83,102	6	7
100181	6,17,27,8,12,1,1,5	7	63,76,83	6	8
110181	24,13,26[C]	7	76,83,102	2	4
120181	26	7	83	1	1[E]
130181	10	3	83	1	1[E]
140181	11	3	83	1	1[E]
170181	2,19	4	76,83	1	2[E]
180181	3,15	4	76,83	1	2[E]
190181	2,11	2	76,83	1	2[E]
200181	1,0,0,4,1	5	57,76	4	5
210181	1,1,6,4,5,2,7,3,2,3,9	7	76,83	6	11
220181	16[C],10[C],12[C]	6	76,102	3	8
230181	13,24,24,5,3,2,2	8	63,76,83,102	4	7
240181	4[C],0,0	2	76,83	2	4
260181	11,18,3,6	5	76,83	3	4
270181	2,10	5	76,83	1	2[E]
280181	4,6	4	76,83	1	2[E]
290181	4,5	4	76,83	1	2[E]
TOTAL	731[A]	11[B]		29[D]	89

A Excludes crabs, prawns or inedible species.

B Total number of different species encountered in month.

C Catch of two or more nets combined.

D Total number of different fishing parties encountered during survey.

E Number of nets set possibly underestimated due to officer's absence.

TABLE 5 . Daily net fishing in Beaufort Inlet, January 1981.

DATE	NUMBER OF FISH CAUGHT PER SET	EDIBLE SPECIES	SIZES OF MESH USED	NET FISHING PARTIES	NETS SET
110181	26,40,44	1	76	1	3
120181	54,22,4	4	76,83	2	3
130181	7,18,4,46,10,47,19	5	76,83,89	6	7
140181	8,69,11,7	4	76	3	4
150181	15,33,15[C],22	2	57,76	3	5
160181	2,34,2,77,20,40,8,15,40,8,13,8	5	57,64,70,76,83,102	7	12
170181	22,38[C],1,1,6,10,7	5	70,76,89	6	8
180181	8,20,4,8,22,4,33,6,2,13,0	4	76,83,89,102	7	11
190181	16,24,6	1	76	1	3
200181	60,10,12,14	3	76,83,114	3	4
210181	22	1	83	1	1[E]
220181	20	1	76	1	1[E]
230181	20,18	2	76,83	2	2[E]
250181	14,16	4	76,83	2	2[E]
270181	104	2	83	1	1
290181	10	1	76	1	1
300181	4,47,6[C],43,49,56[C]10,42[C]	4	64,76,83,89	7	11
TOTAL	1616[A]	7[B]		24[D]	79

A Excludes crabs, prawns or inedible species.

B Total number of different species encountered in month.

C Catch of two or more nets combined.

D Total number of different fishing parties encountered during survey, who set nets.

E Number of nets set possibly underestimated due to officer's absence from area.

TABLE 6. A comparison of the catches and catch rates of sea mullet by 30 m monofilament nets from day sets at two lightly fished sites in Beaufort Inlet, January 1981.

NAME	DATE	SITE	NO. OF SEA MULLET	MESH (mm)	START TIME	DURATION (MIN)	EQUIVALENT CATCH RATE (FISH/HOUR)	COMMENT
Fisherman A	11.01.81	16	26	76	1300 hr	90	17	First Set
Fisherman A	11.01.81	16	44	76	-	60	44	Second Set
Fisherman A	11.01.81	16	40	76	-	90	26	Third Set
Fisherman B	19.01.81	23	16	76	1200 hr	100	10	First Set
Fisherman B	19.01.81	23	24	76	1415 hr	20	72	Second Set
Total	2 days		150			6 hr, Mean =	25*	

* Mean refers to mean fish catch rate.

TABLE 7. Mean catch rates (No. per overnight set) of fish and crabs caught by different sized mesh in Wellstead estuary January 1981. Brackets denote catch from a single set.

MESH SIZE (mm)	57	63	76	83	102
SPECIES					
Cobbler		0.7	0.1	0.4	-
King George whiting		0.1	0.1	0.1	-
Australian herring		0.8	0.4	0.8	-
Australian salmon		-	<0.1	-	-
Black bream		-	0.6	0.3	2.5
Silver bream		-	0.1	0.1	0.5
Sea mullet	(1)	10.5	2.1	1.0	-
Yellow-eye mullet		2.0	0.4	0.1	-
Leatherjacket		0.6	1.2	7.0	4.5
Blue manna crab		-	<0.1	0.3	-
Summed mean catch rates for edible species	(1)	14.7	ca. 5.1	10.1	7.5
No. of sets	1	12	49	21	4

TABLE 8. Mean fish catch rates (No. per overnight set) by different mesh sizes used in the Beaufort Inlet January 1981. Brackets denote catch from a single set.

MESH SIZE (mm)	57	63	70	76	83	89	102	114
SPECIES								
Cobbler	-	-	4.0	0.7	0.5	0.1	-	
King George whiting	0.2	-	-	0.1	-	-	-	
Black bream	-	-	2.5	1.1	-	0.5	7.0	(10)
Silver bream	0.2	-	-	0.1	-	-	-	
Sea mullet	3.8	24.3	26.5	14.5	27.4	5.0	-	-
Yellow eye mullet	6.5	1.3	0.5	0.9	0.1	0.5	-	-
Summed mean catch rates for edible species	10.7	25.6	33.5	ca. 17.2	28	6	7	(10)
No. of sets	4	3	2	50	13	4	2	1

TABLE 9. Size composition, mean length and standard deviation (S) of sea mullet caught by set nets of different mesh size in Wellstead estuary (BR) and the Beaufort Inlet (PA) in January, 1981.

MESH SIZE (mm)	57		63		70		76		83		89		102		114		TOTAL	TOTAL
TOTAL LENGTH CLASS (cm)	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA
24 cm	MINIMUM LEGAL SIZE																	
26								1				1						2
27			1	1													1	1
28		1	1	4		4		13		1							1	23
29		2	4	10		10	1	43		1		1					5	67
30		1	10	18		7	4	93		3		5					14	127
31		2	16	15		10	8	122		6		4					24	159
32		2	28	8		5	17	96	1	9		4					46	124
33			24	7		5	18	43	1	3		4					43	62
34			24	2		3	24	21	3	1		1					51	28
35			13				7	2	5								25	2
36			2				7		1								10	
37			3				1										4	
TOTAL		8	126	65		44	87	434	11	24		20					224	595
% MESH USED	1	5	13	4		2	55	61	24	16		8	5	2		1		
MEAN LENGTH		30.9	33.1	31.2		31.1	33.6	31.6	34.8	31.9		31.6						
S		1.3	1.8	1.5		1.7	1.6	1.4	1.1	1.4		1.8						

TABLE 10. Size composition, mean length and standard deviation (S) of six-spined leatherjacket caught by set nets of different mesh size in Wellstead estuary in January, 1981.

MESH SIZE (mm)	57	63	70	76	83	89	102	114	TOTAL
TOTAL LENGTH CLASS (cm)									
21					1				1
22		1		2	2		1		6
23				2	9				11
24		1		7	12		1		21
25	MINIMUM	1	LEGAL	5	17	SIZE	6		29
26		1		8	10		6		25
27		1		10	9		3		23
28				8	6		1		15
29		1		1	1				3
TOTAL		6		43	67		18		134
%MESH USED	1	13		55	24		5		
MEAN LENGTH		26.0		26.2	25.5		26.0		
S		2.1		1.8	1.7		1.4		

TABLE 11. Size composition, mean length and standard deviation (S) of yellow-eye mullet caught by set nets of different mesh size in Wellstead estuary (BR) and the Beaufort Inlet (PA) in January, 1981.

Brackets denote individual measurement, not mean.

MESH SIZE (mm)	57		63		70		76		83		89		102		114		TOTAL	TOTAL
TOTAL LENGTH CLASS (cm)	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA
21							1										1	
22																		
23	MINIMUM LEGAL SIZE																	
24							1										1	
25								2		1								3
26		6		1				7		2								16
27		2						11										13
28		8		1		1	1	7				2					1	19
29		8	2	2				2									2	12
30		1	9				3	1	2								14	2
31		1	7				7	1									14	2
32			1				1										2	
33																		
34			1				1										2	
35																		
36			2														2	
37			1														1	
38			1														1	
39							2										2	
TOTAL		26	24	4		1	17	31	2	3		2					43	67
% MESH USED	1	5	13	4		2	55	61	24	16		8	5	2		1		
MEAN LENGTH		28.4	32.0	28.4		(28.4)	31.2	27.7	30.8	26.3		28.2						
S		1.3	2.6	1.6			4.3	1.3	0.1	0.3		0.1						

TABLE 12. Size composition, mean length and standard deviation (S) of black bream caught by set nets of different mesh size in Wellstead estuary (BR) and the Beaufort Inlet (PA) in January, 1981.

MESH SIZE (mm)	57		63		70		76		83		89		102		114		TOTAL	TOTAL
TOTAL LENGTH CLASS (cm)	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA
19							1										1	
20								1				1	1				1	2
21						1	4	1				1	3				7	3
22						1	5	5	1				1				7	6
23							7	3					1				8	3
24							7	1					1				8	1
25	MINIMUM						1	1	LEGAL				1	SIZE			2	1
26							3		1				1				5	
27						1		3	1					1			1	5
28								1					1	1			1	2
29						2		5						2				9
30								4						3				7
31								2						2				4
32								3						1				4
33								1										1
34														2				2
35																		
36								1										1
41													1				1	
TOTAL						5	28	32	3			2	11	12			42	51
% MESH USED	1	5	13	4		2	55	61	24	16		8	5	2		1		
MEAN LENGTH						26.1	23.4	27.7	25.3			21.1	24.9	30.9				
S						3.9	1.6	4.2	2.3			1.0	6.3	2.1				

TABLE 13. Size composition, mean length and standard deviation (S) of Australian herring caught by set nets of different mesh size in Wellstead estuary in January, 1981.

MESH SIZE (mm)	57	63	70	76	83	89	102	114	TOTAL
TOTAL LENGTH CLASS (m)									
18	MINIMUM		LEGAL		SIZE				
22				1	1				2
23				3	2				5
24		3		9	1				13
25		5		5	3				13
26		2		1					3
TOTAL		10		19	7				36
%MESH USED	1	13		55	24		5		
MEAN LENGTH		25.4		24.6	24.2				
S		0.8		0.9	1.1				

TABLE 14. Size composition, mean length and standard deviation (S) of cobbler caught by set nets of different mesh size in Wellstead estuary (BR) and the Beaufort Inlet (PA) in January, 1981.

MESH SIZE (mm)	57		63		70		76		83		89		102		114		TOTAL	TOTAL
TOTAL LENGTH CLASS (cm)	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA	BR	PA
25	MINIMUM LEGAL SIZE CALCULATED FROM DORSAL FIN																	
37			1				1		1								3	
38			1														1	
39			1														1	
40			3														3	
41			1					2									1	2
42						3		1										4
43								4										4
44						3		2										5
45						1		3										4
46								7				1						8
47						1		4										5
50								1										1
51																		
52								1										1
53									1								1	
55							1		1								2	
57			1				1										2	
58									1								1	
60							1										1	
63							1										1	
67							1										1	
TOTAL			8		8		6	25	4		1						18	34
% MESH USED	1	5	13	4	2		55	61	24	16	8		5	2	1			
MEAN LENGTH			41.8		44.3		53.2	45.8	47.7		46.5							
S			6.8		1.8		19.2	2.5	16.2									

TABLE 15. Length - weight relationships for important fish species caught by set net in (a) Wellstead estuary and (b) Beaufort Inlet in January 1981.

(a) Wellstead estuary

SPECIES	NUMBER	EQUATION
Sea mullet	221	$W = 3.276 \times 10^{-5} L^{2.7949}$
Yellow-eye mullet	49	$W = 2.240 \times 10^{-6} L^{3.252}$
Cobbler	16	$W = 4.158 \times 10^{-5} L^{2.646}$
Six-spined leatherjacket	147	$W = 4.058 \times 10^{-5} L^{2.806}$
Black bream	45	$W = 3.039 \times 10^{-6} L^{3.3044}$
Australian herring	43	$W = 8.677 \times 10^{-6} L^{3.046}$

(b) The Beaufort Inlet

SPECIES	NUMBER	EQUATION
Sea mullet	302	$W = 8.82 \times 10^{-6} L^{3.055}$
Yellow-eye mullet	68	$W = 5.15 \times 10^{-7} L^{3.521}$
Cobbler	34	$W = 3.739 \times 10^{-6} L^{3.033}$
Black bream	50	$W = 3.383 \times 10^{-6} L^{3.282}$

TABLE 16. How actual catches of fish and crabs from set nets measured up to the expectation of amateur fishermen in (a) Wellstead Estuary and (b) Beaufort Inlet in January 1981.

(a) Wellstead estuary	DAYS OF JANUARY																										
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTALS
Catch below expectation		1		5	2	4	2		1	1			1	1	1	5	10	6	3	4		1	1	2	2		53
Catch at expectation	2		1	3	4	2	2	1					1	1	1		1	2	2			1	1				25
Catch above expectation			1	2	1	1													2			1					8
First time set			1			1																1					3
SAMPLED DAILY SETS	2	1	3	10	7	8	4*	1*	1*	1*	-*	-*	2*	2*	2*	5	11	8	7	4	-	4	2*	2	2*	-*	89

(b) Beaufort Inlet	DAYS OF JANUARY																										
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	TOTALS
Catch below expectation									3		1	5	3	4			1		1		1				1	3	23
Catch at expectation								1	2	3	2	2	4	6	1	2		1	1		1					2	28
Catch above expectation							3	2	2	1	2	5		1	2	2							1			4	25
First time set													1													2	3
SAMPLED DAILY SETS	-*	-*	-*	-*	-*	-*	3	3	7	4	5	12	8	11	3	4	1*	1*	2*	-*	2*	-*	1	-	1	11	79

* indicates sample was probably less than total sets for that day.

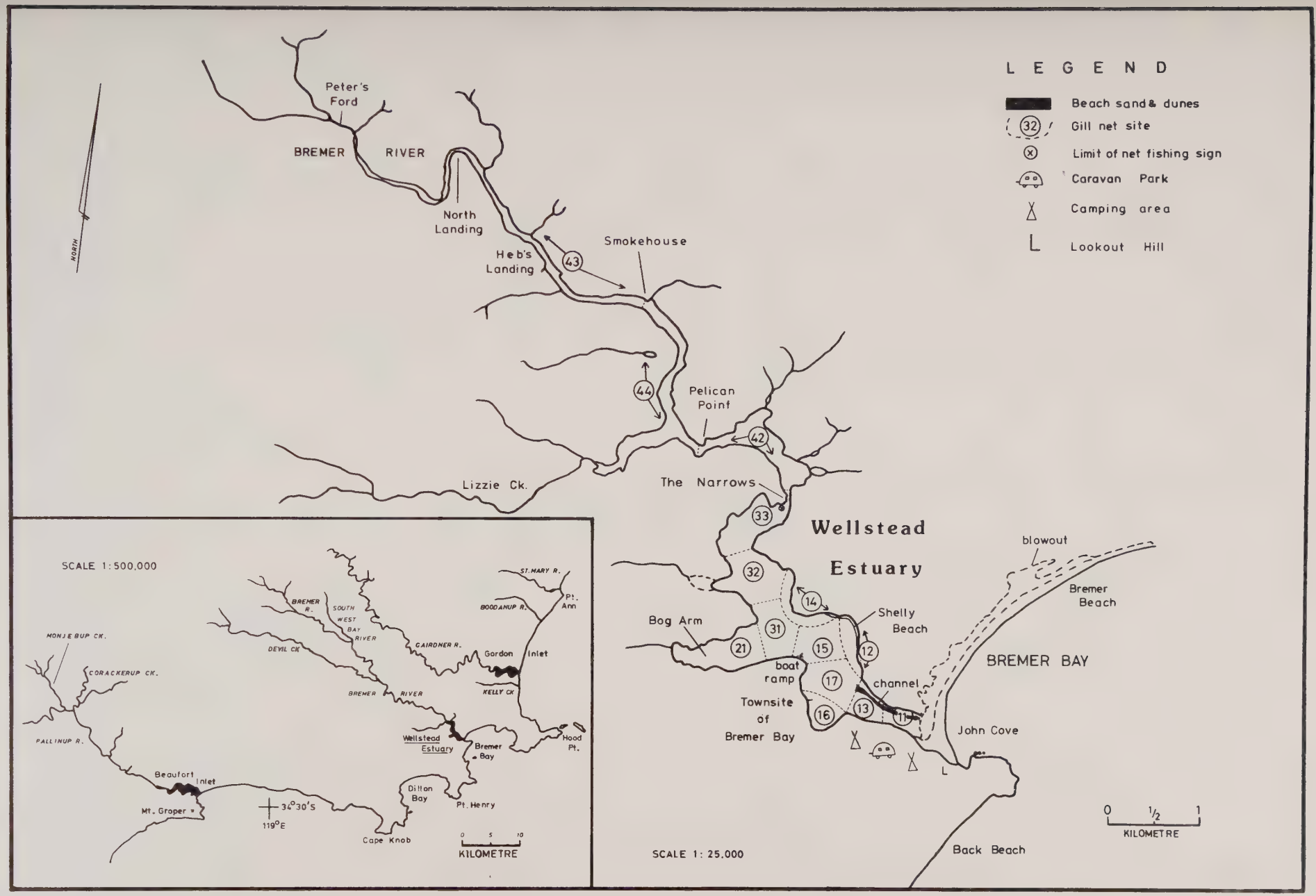


Figure 1. Wellstead estuary and Bremer River, showing net fishing sites and the relationship of this system to other south coast estuaries.

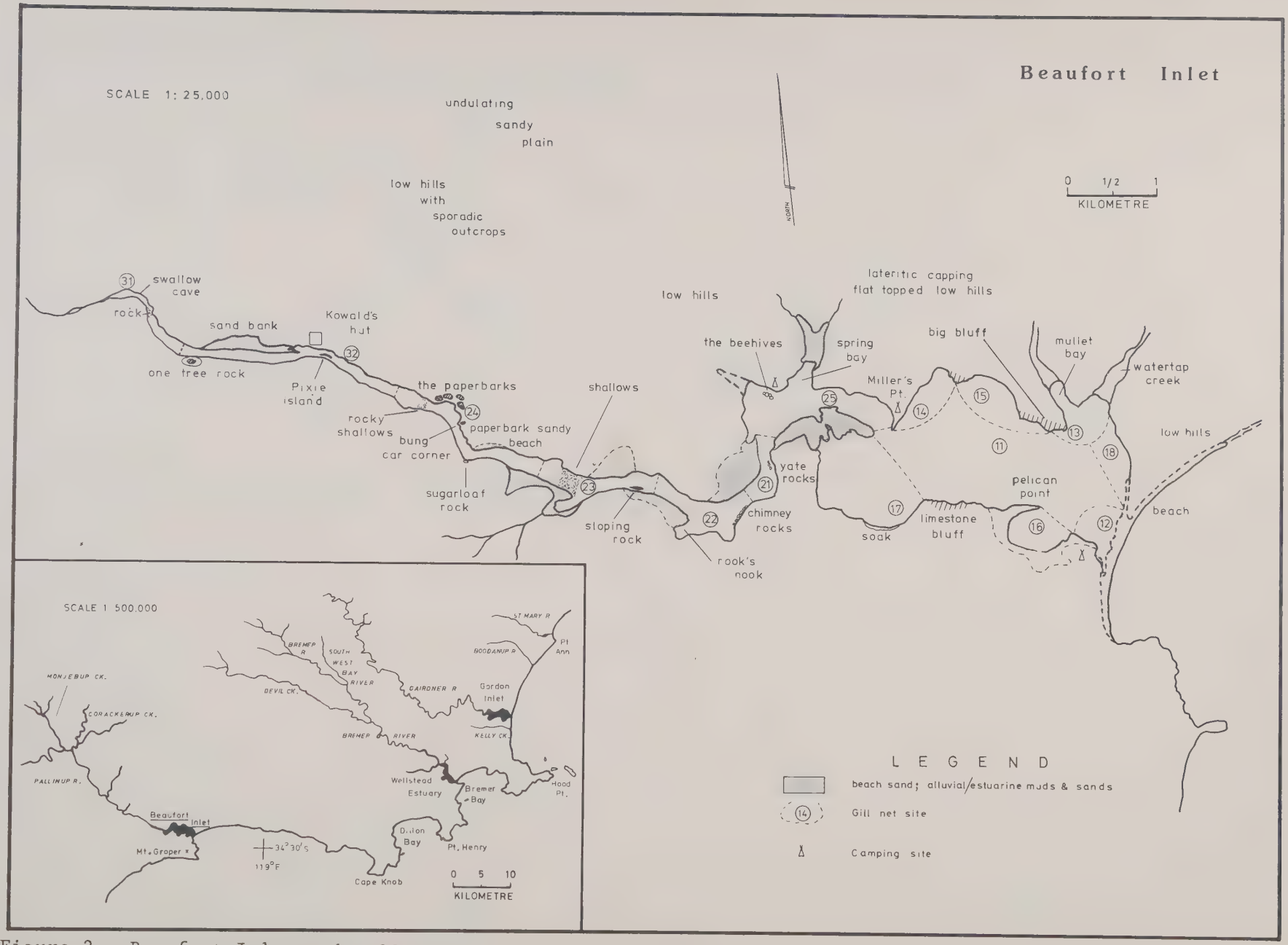
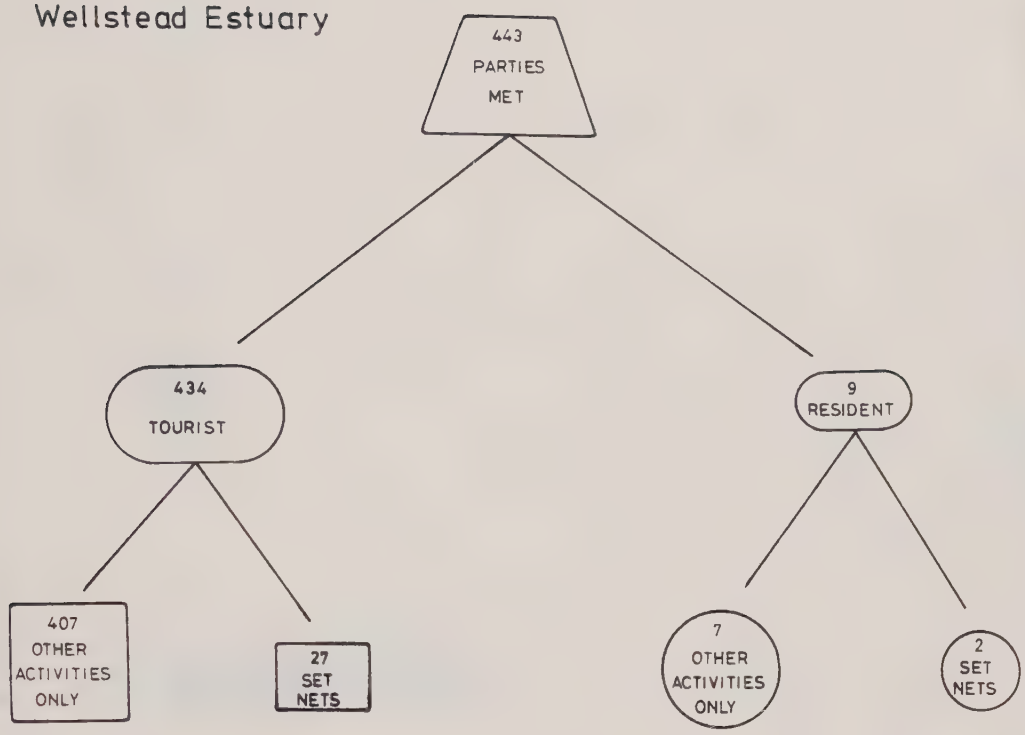


Figure 2. Beaufort Inlet and Pallinup River, showing net fishing sites and the relationship of this system to other south coast estuaries.

(a) Wellstead Estuary



(b) Beaufort Inlet

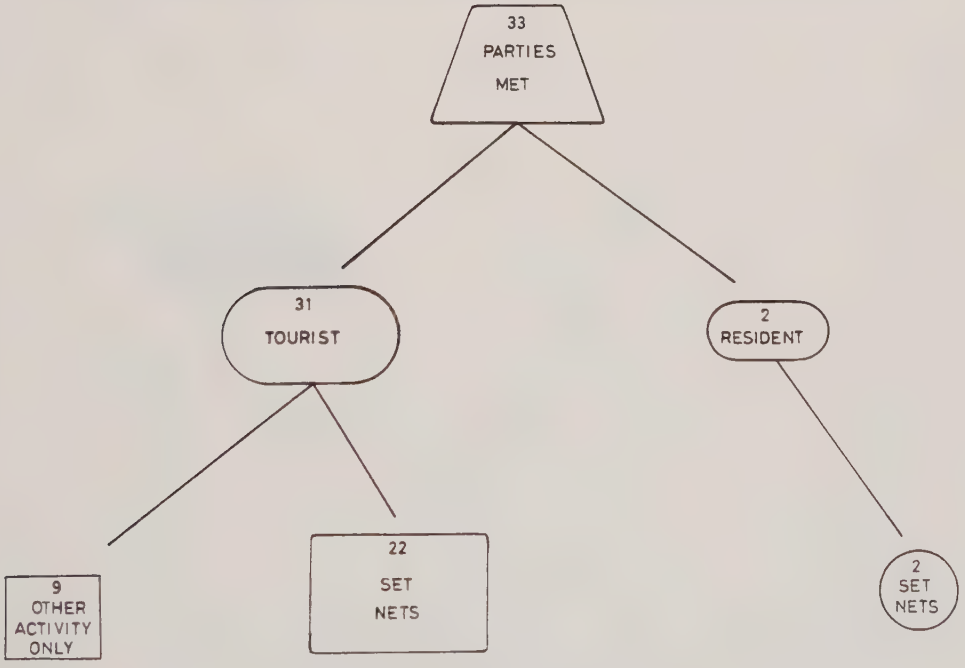


Figure 3. The number of and status of net fishing parties amongst those parties interviewed from (a) Wellstead estuary and (b) Beaufort Inlet during the January 1981 survey.

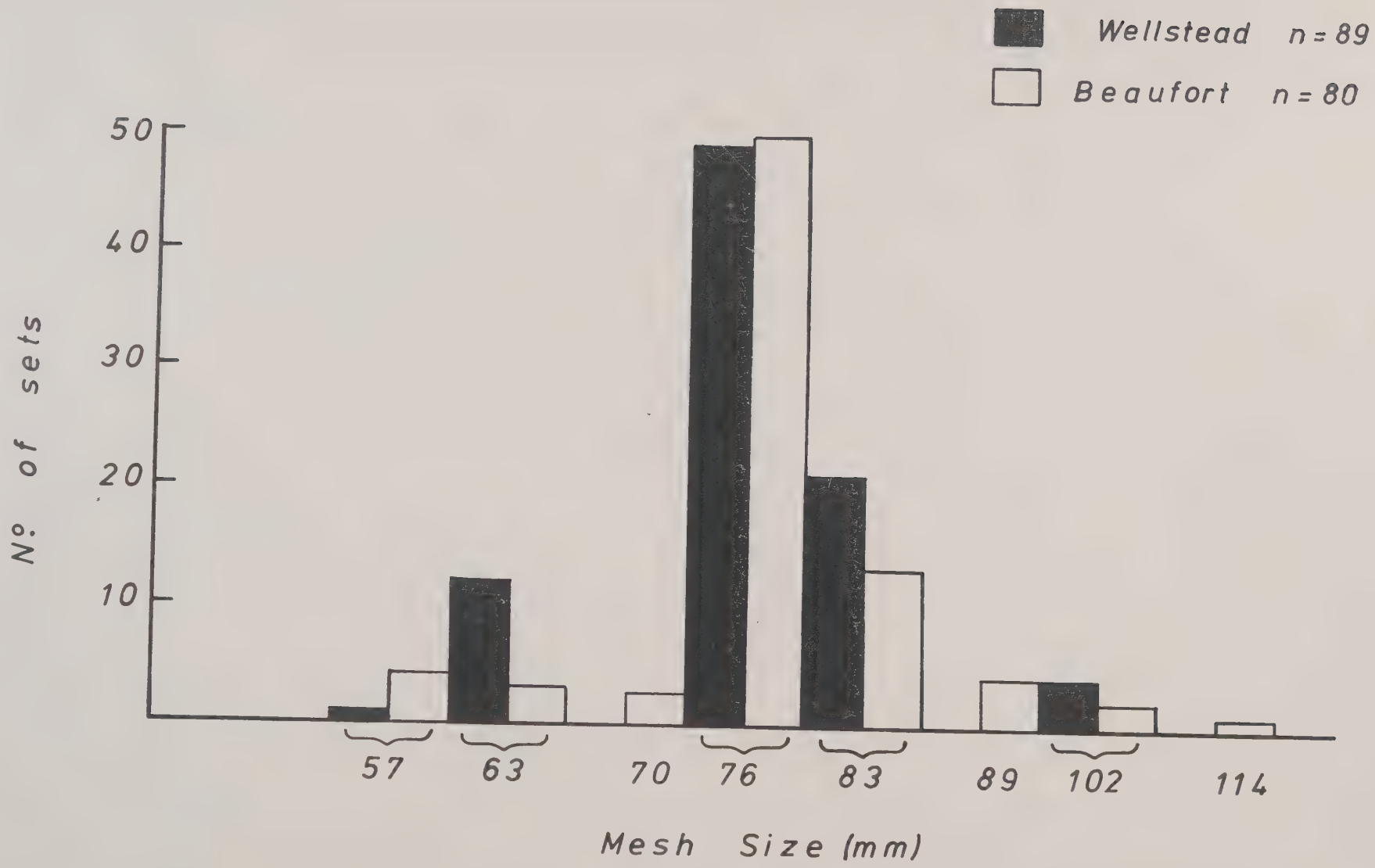


Figure 4. Distribution of fishing effort in respect of mesh size.

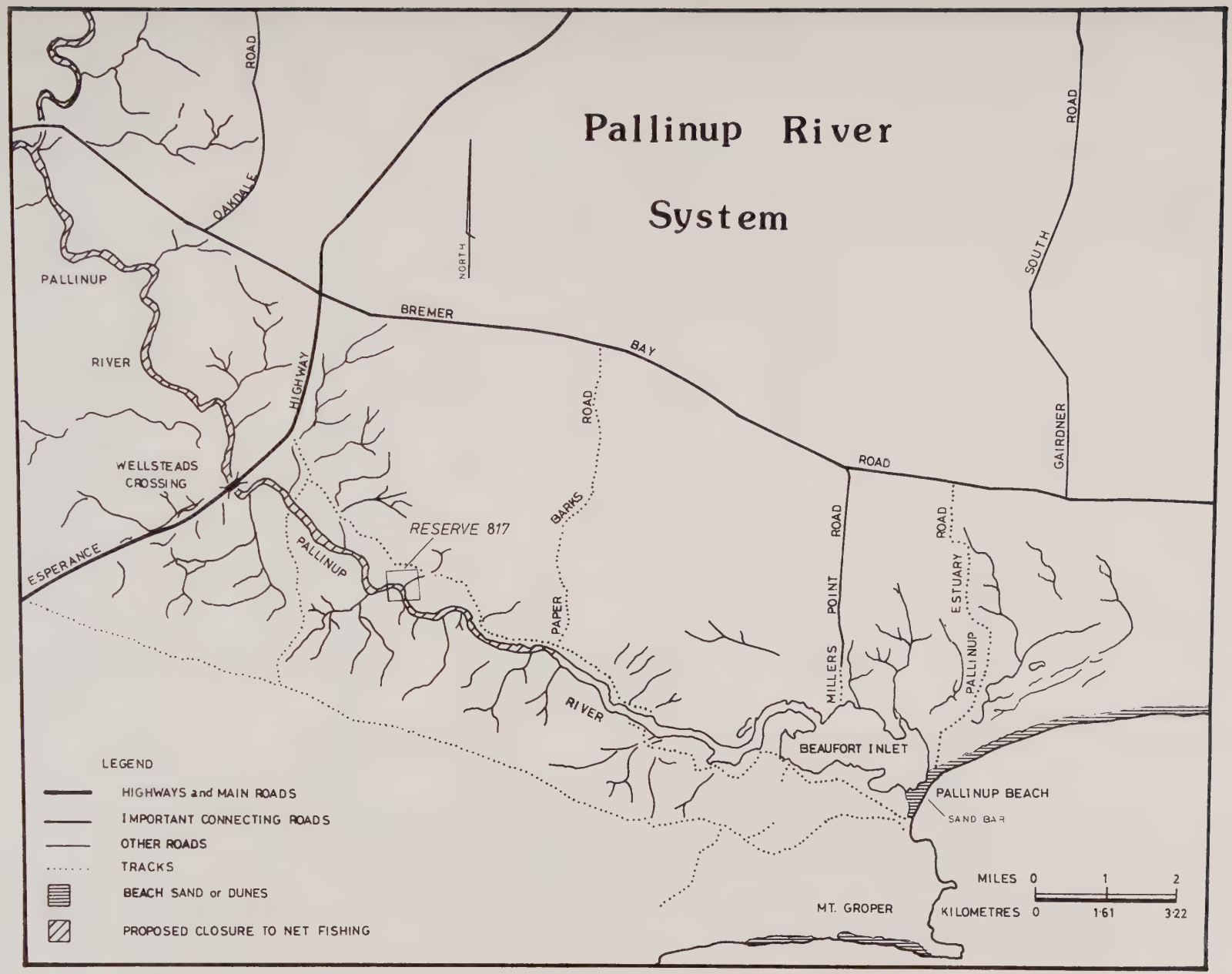


Figure 5. Coastal features of Pallinup River - Beaufort Inlet, showing part of the river for which a closure to net fishing is proposed.

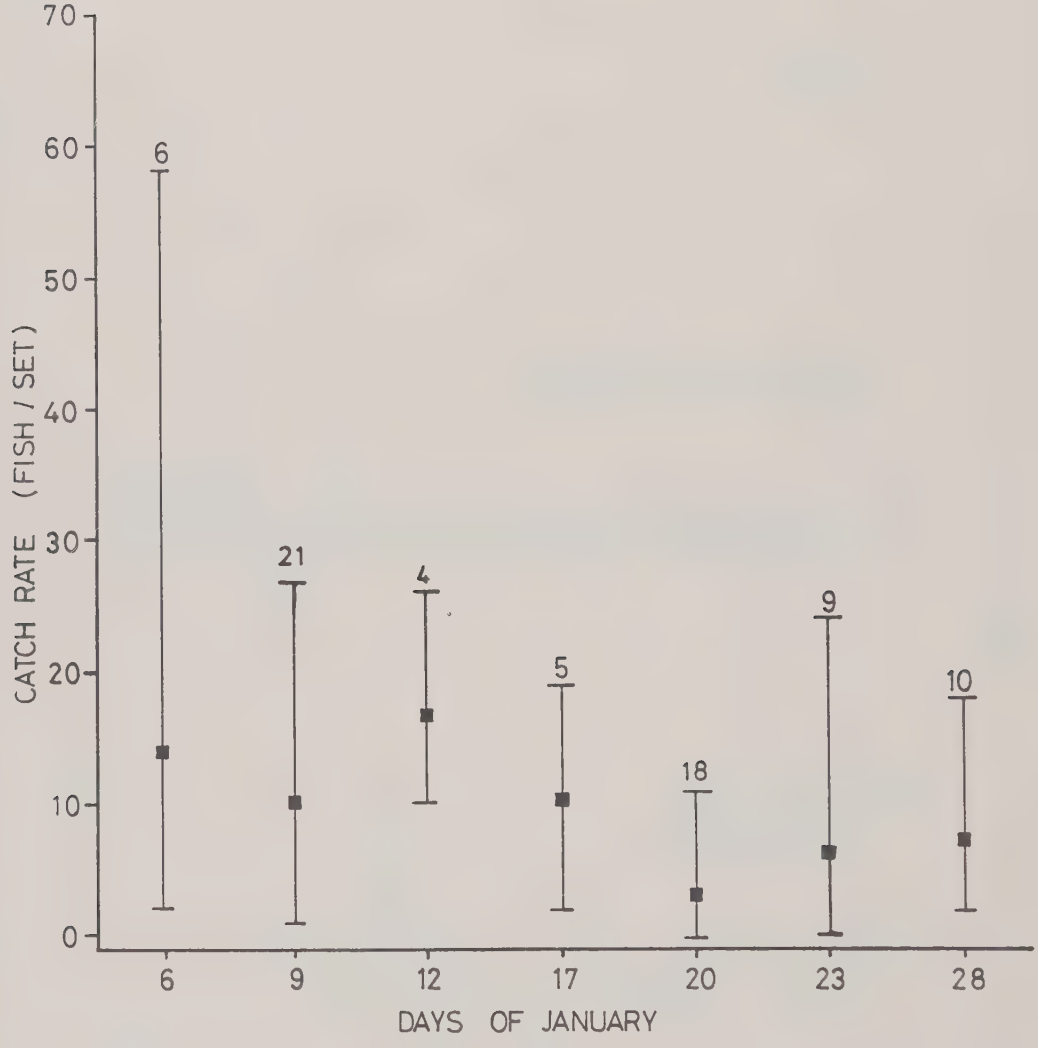


Figure 6. Catch rates of edible fish in Wellstead estuary January 1981, plotted as mean ■ and range I for three day intervals. The number of samples is shown at the maximum point.

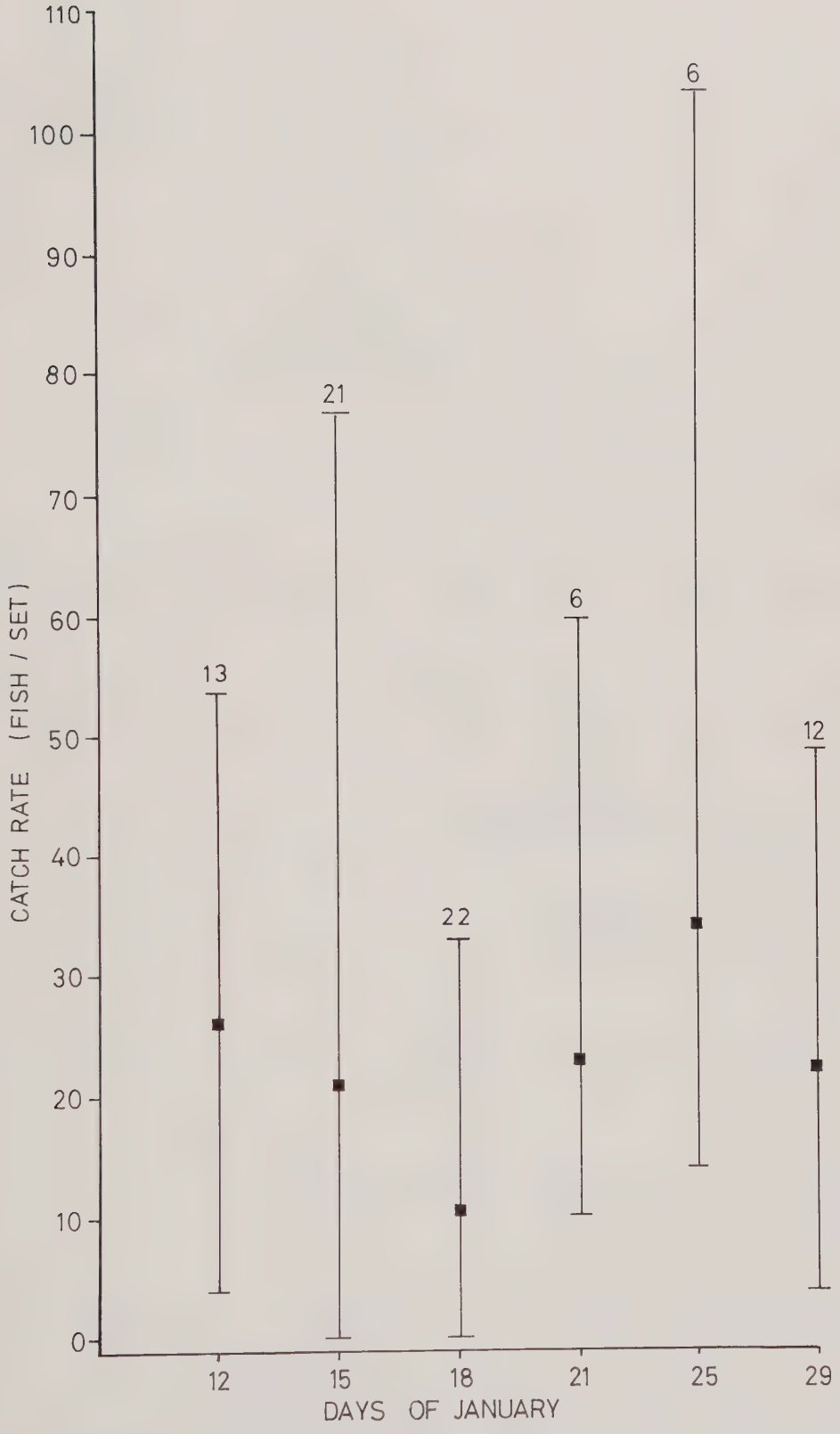


Figure 7. Catch rates of edible fish in Beaufort Inlet, January 1981, plotted as mean ■ and range I for three day intervals. The number of samples is shown at the maximum point.

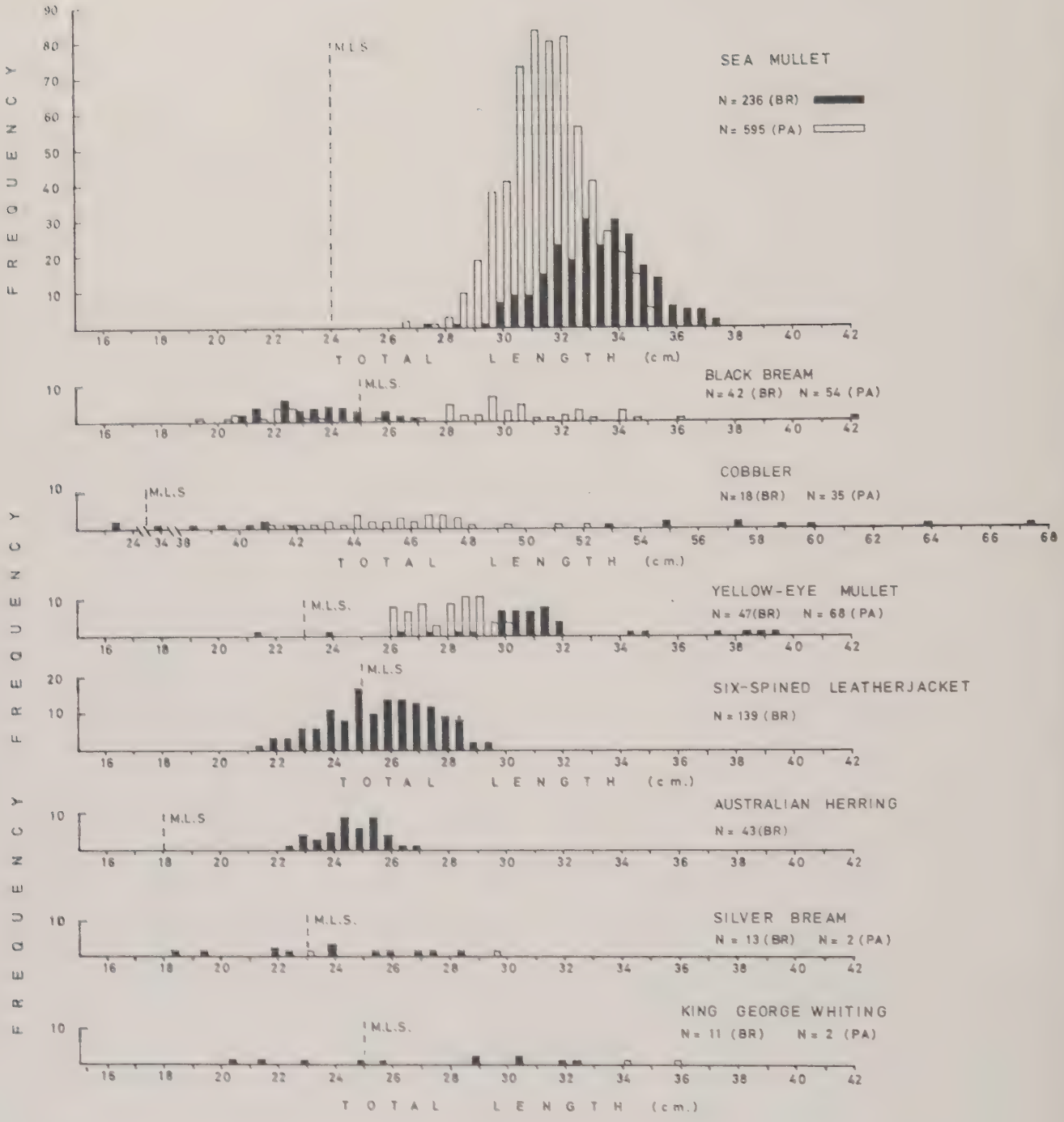


Figure 8. Length composition of the total measured catch of selected species of fish taken in all sizes of mesh combined from Wellstead estuary (BR ▬) and Beaufort Inlet (PA ▭). M.L.S. is minimum legal size. The M.L.S. for cobbler was estimated from an equation relating fin length to total length.

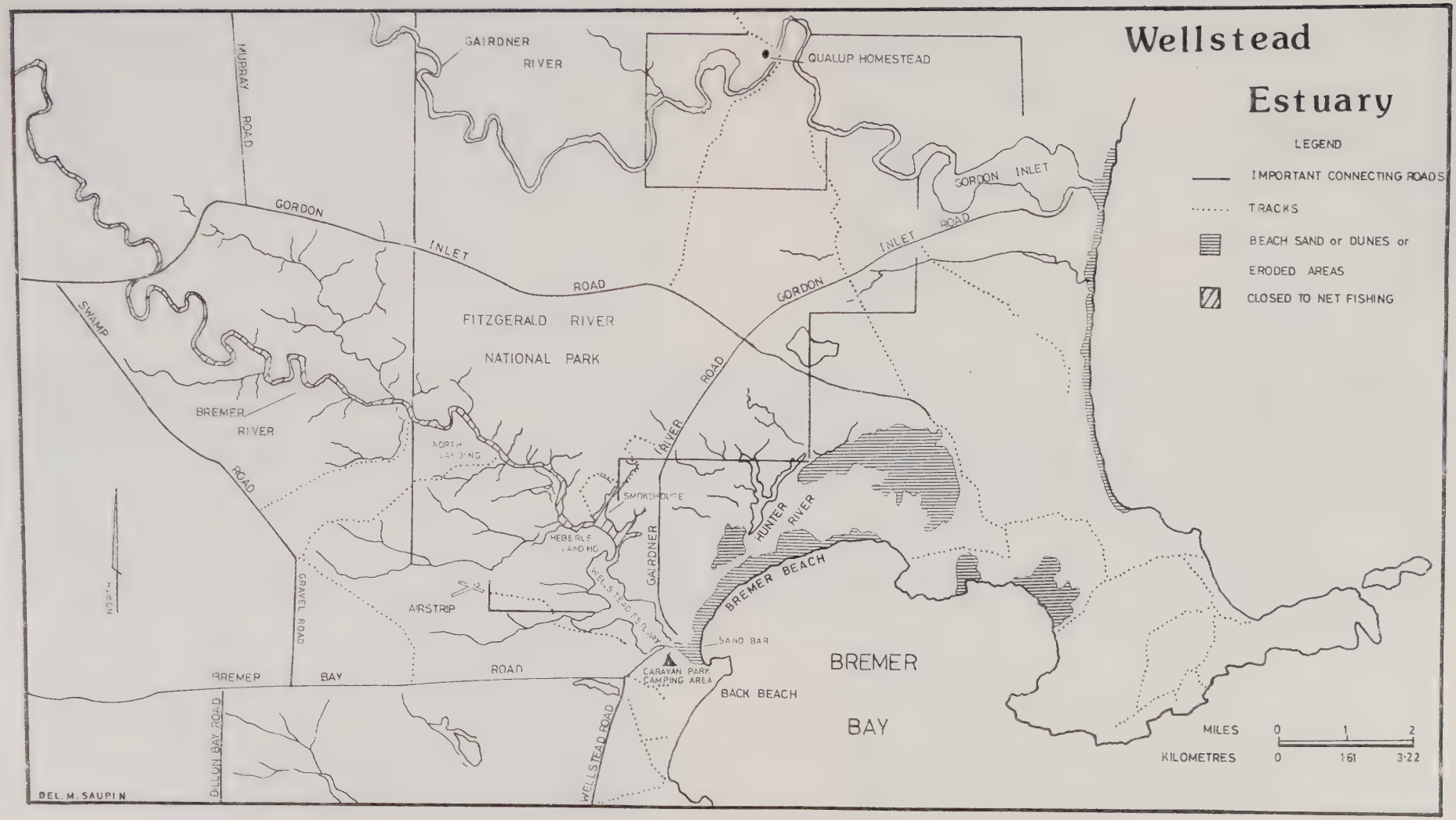


Figure 9. Coastal features of the Bremer Bay area, showing access roads and part of the Bremer River closed to net fishing.

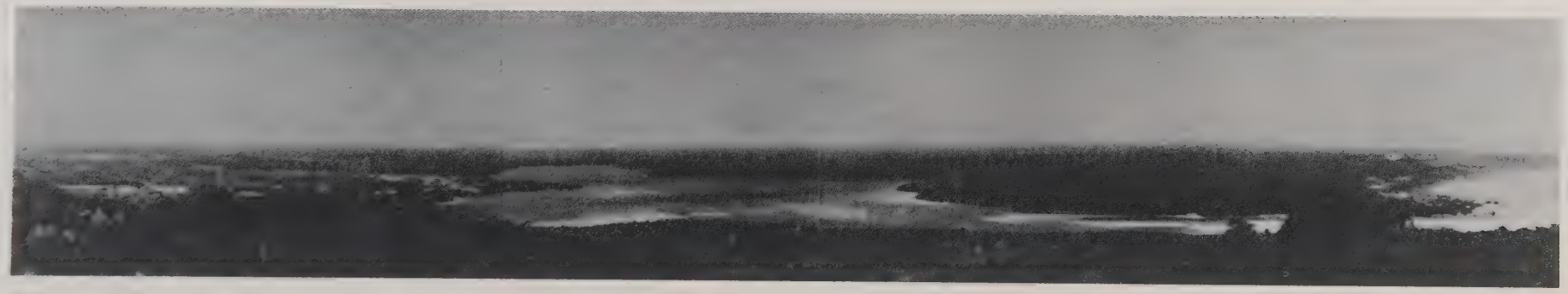


Plate 1. Panorama of Wellstead Estuary, from Lookout Hill. Taken in April 1981. Water level is very low. The barrier sandbar is at right and Bog Arm is at left (see also Figure 1).

Plate 2. View of Wellstead Estuary, late one afternoon in January 1981, looking up the estuary towards site 32.

Plate 3. A fishing party at Beaufort Inlet hauling in a set net from the southern end of site 18, near the barrier sandbar.

Plate 4. A view of Swallow Cave, Pallinup River from the opposite shore looking downriver (refer also to Figure 2).

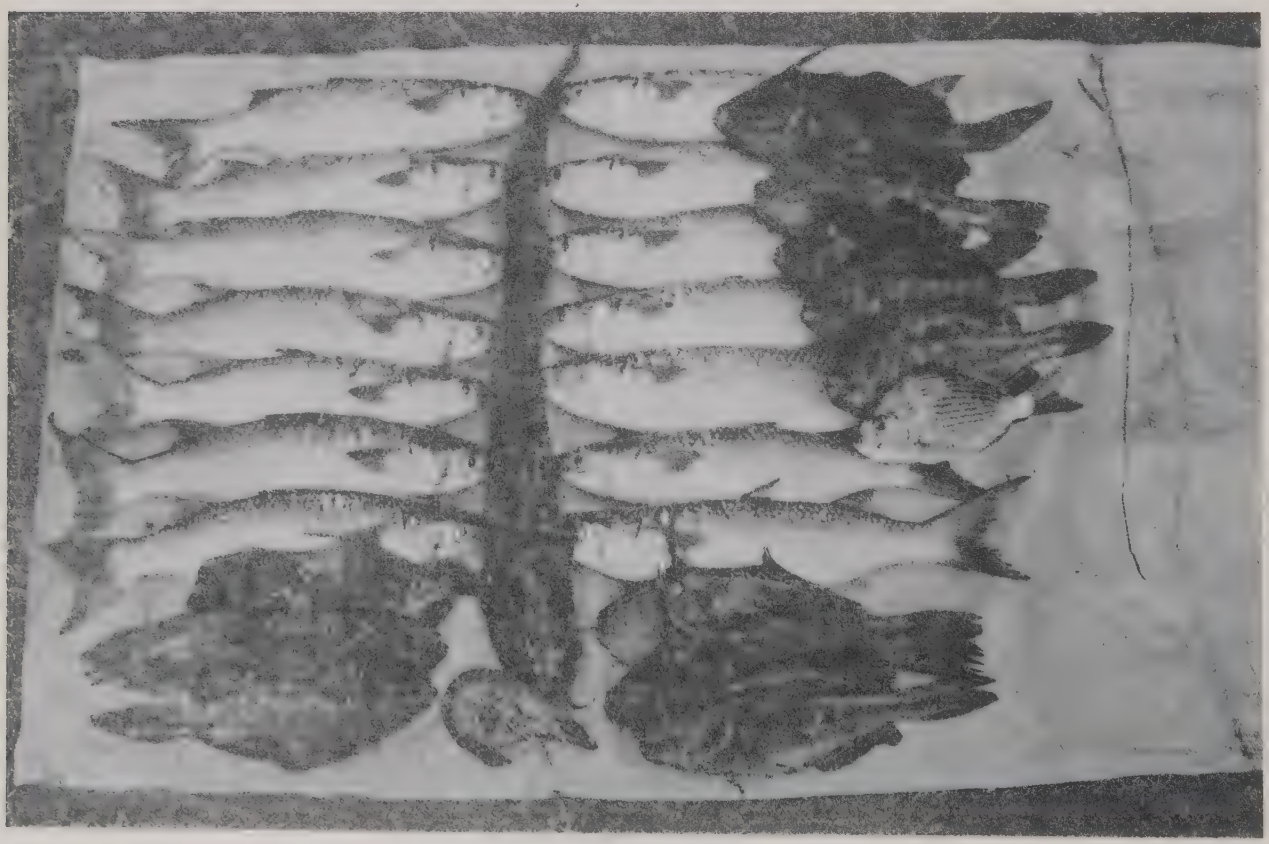


Plate 5. An above average catch from an amateur net set in Wellstead Estuary in January 1981 by Ken and Isobel Burchell.

Plate 6. *Mugil cephalus*, the sea mullet.

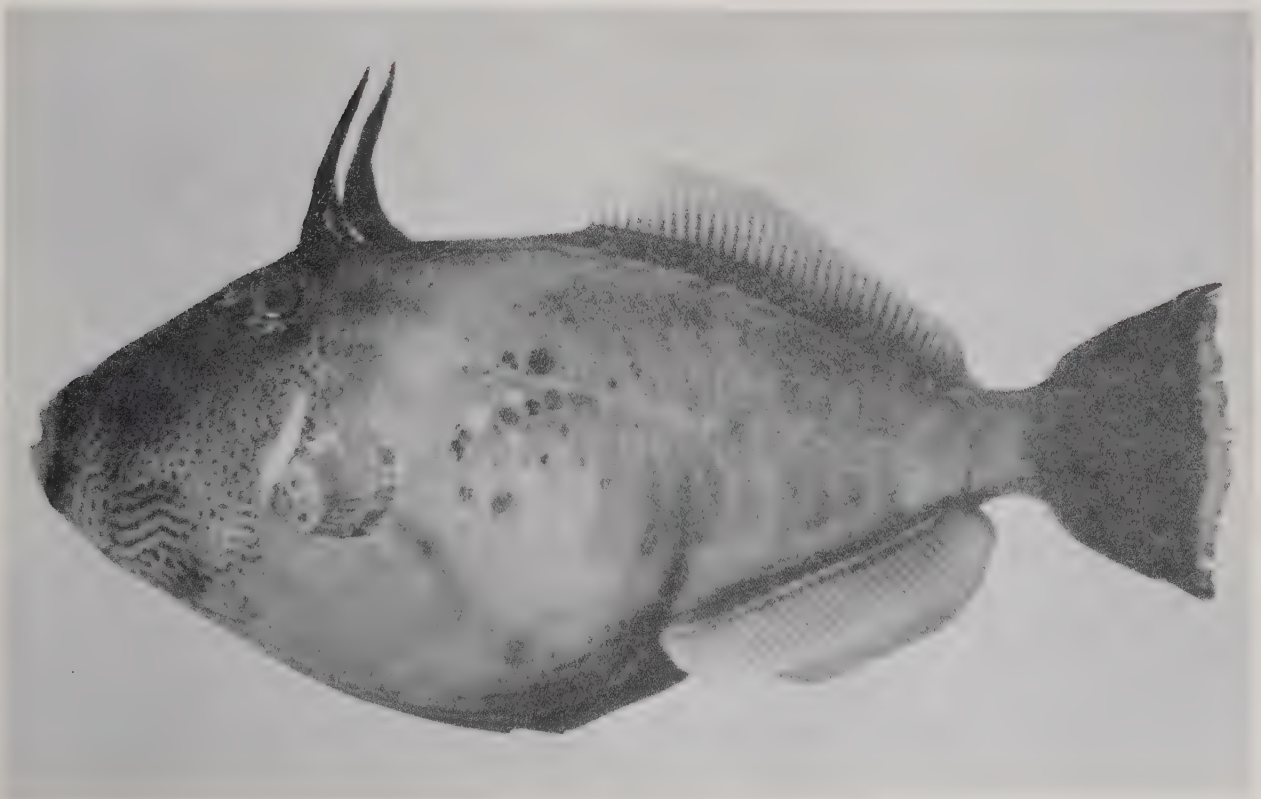


Plate 7. *Meuschenia freycineti*, the six-spined leatherjacket.

Plate 8. *Aldrichetta forsteri*, the yellow-eye mullet.

Plate 9. *Acanthopagrus butcheri*, the black bream.

Appendix 1. Shire of Gnowangerup by-laws relating to fishing which were in effect between 1938 and October 3, 1980.

WESTERN AUSTRALIA

LOCAL GOVERNMENT ACT 1960 (As amended)

THE MUNICIPALITY OF THE SHIRE OF GNOWANGERUP.

BY-LAWS RELATING TO FISHING.

In pursuance of the powers conferred upon it by the above-mentioned Act and of all other powers enabling it the Council of the abovementioned Municipality hereby records having resolved on the 28th day of July, 1971 to make and submit for confirmation by the Governor the following by-laws:-

1.In these by-laws unless the context requires otherwise:-

" Council" means the Council of the Shire of Gnowangerup.

" Fish" means and includes all or any of the varities of marine or fresh water fishes and crustacea or marine animal life.

" Fixed Engine" includes any hedge fence weir stake-net trap or any fixed implement for catching or facilitating the catching of fish.

"Licence" means a licence issued by the Council under these by-laws.

"Officer" means and includes any member of the Council the Shire Clerk of the Council any person appointed by the Council to exercise authority under or to enforce the provisions of these by-laws and members of the Police Force.

" Reserve " means any reserve vested in or under the control of the Council.

"Shire Clerk" means the Shire Clerk of the Council.

"Waters" means any river creek stream or other waters vested in or under the control of the Council.

2. No person shall take catch or trap or attempt to take catch or trap fish in waters on a reserve by means of a fishing net unless he is the holder of a licence issued under those by-laws.

3. Applications for licences shall be made in accordance with Form 1 in the schedule to these by-laws.

4. Licences shall be issued in accordance with Form 2 in the Schedule hereto and subject to the conditions specified therein.

4. A fee of TWO DOLLARS ($2.00) shall be paid to the Council before the issue of any licence.

6. A licence shall be valid until the 30th day of September next following the date of issue thereof.

7. A licence shall not be transferred by the holder thereof to any other person.

8. A person shall not be entitled to be the holder of more than one licence.

9. No person under the age of seventeen (17) years shall be entitled to hold a licence. The Council or any Officer may require an applicant for a licence to furnish with his application such evidence of his date of birth as it or he shall think fit.

10. A licence shall entitle the holder thereof to take catch or trap fish in waters on a reserve by means of a fishing net not more than seventy yards in length and having mesh not less than three inches and not othwerise.

11. The holder of a licence shall keep attached to any fishing net which is used or intended to be used by him a float of not less than four inches in diameter which shall be legibly marked and kept marked either by painting branding or otherwise stamping on the float the number of the licence held by such person.

12. For the purpose of testing the length of any fishing net such net shall be measured along the cork line upon which the net is hung. The size of the mesh shall be determined by measuring from knot to knot on the inside of the mesh when ready for use and stretched so that the opposite knots on the alternative corners are in contact. In the event of the net being dry the part to be measured shall be soaked either in fresh water or in salt water for not less than ten minutes and the dimensions of the mesh or meshes of the portion so soaked shall thereupon be determined.

13. No person shall obstruct any waters or the passage of any boat or vessel through in or across any waters by the use of a fishing net lines floats or a boat vessel debris or any other means.

14. No person shall capture kill or destroy or attempt to capture kill or destroy any fish in the waters on any reserve by the discharge or use of any speargun rifle or other firearm whatsoever or by use of any explosive howsoever ignited or exploded.

15. Any person using having used or being about to use a fishing net or take fish in the waters on any reserve or being in possession of a fishing net on any reserve shall forthwith on demand by any officer produce his licence and if required by an officer permit such net to be measured not only as to length but also as to size of mesh and give his name and address.

16. An officer may seize any fishing net which is being used or which he suspects on reasonable grounds is about to be or has been used by a person who is not the holder of a licence or which does not comply with or conform to the requirements of these by-laws.

17. No person shall at any time use a fixed engine to take catch or trap or to attempt to take catch or trap fish in waters on a reserve.

18. All fishing nets fixed engines and other property or articles (but not including any boat) used by or in the possession of any person contrary to the provisions of these by-laws shall be forfeited to Her Majesty.

19. When any boat net line fixed engine implement appliance or other article for taking fish shall be found by an officer in any waters without any person in actual possession thereof the Officer may seize such boat net line fixed engine implement appliance or other article and such Officer shall give notice of finding thereof by notice on the Council's notice board and shall thereafter cause the thing so found to be taken before a justice who shall if satisfied that there are reasonable grounds for believing that the thing in question had been or was intended to be used in contravention of these by-laws condemn the same as forfeited to Her Majesty and the same shall be forfeited accordingly.

20. Any person who shall assault restrict obstruct or delay interfere with or give false information to or use abusive language to any officer when in the execution of his duties or authority under these by-laws and any person who shall direct or encourage any other person to do so commits an offence.

21. Any person who shall commit a breach of any of these by-laws shall be liable to a fine not exceeding ONE HUNDRED DOLLARS ($100.00).

22. The Council may by resolution revoke the licence issued to a person who has been convicted of any offence against these by-laws.

23. The by-laws relating to fishing published in the Government Gazette of the 26th September, 1968 are hereby repealed.

AMENDMENT.

In pursuance of the powers conferred upon it by the abovementioned Act and of all other powers enabling it, the Council of the abovementioned Municipality hereby records having resolved on the 16th day of January 1974 to make and submit for confirmation by the Governor the following amendment to the by-laws relating to Fishing made on the 29th day of December, 1972.

The by-laws are amended by adding after by-law twenty three a by-law as follows:-

24- (1) The Council may, by notice publish in the Government Gazette prohibit all persons from)
(a) taking any specified species of fish by any specified means of capture;

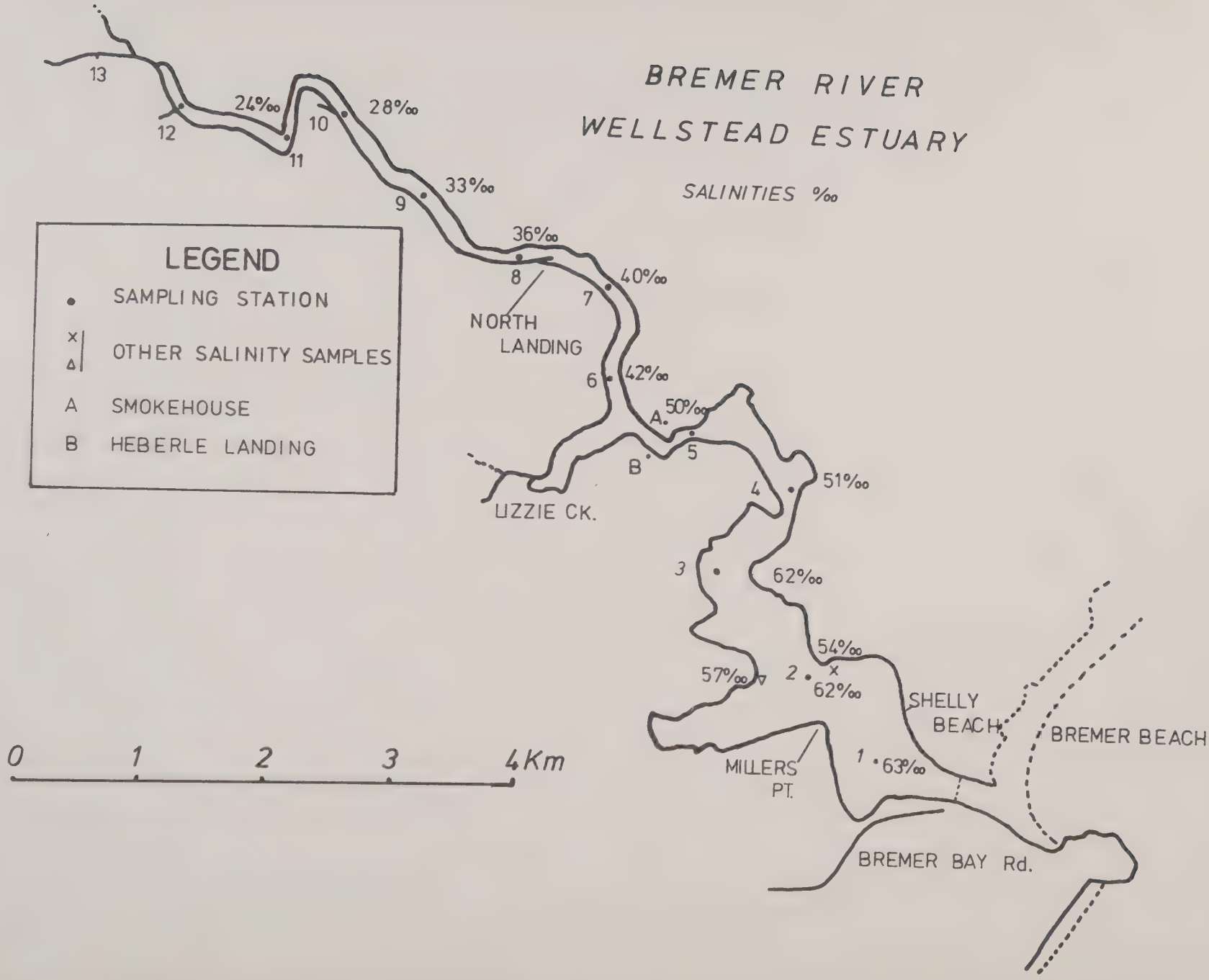
(b) Taking any fish whatsoever by any specified means of capture;

(c) taking any specified species of fish by any means of capture whatsoever;

(d) taking any fish whatsoever by any means of capture in waters on a reserve or in any specified time in any specified year during a specified portion of every year or until a further notice is so published.

Appendix 2. Details of the opening and closure to the sea of Wellstead Estuary from all available records. Intervals rounded to nearest whole number of months.

Bar open	Bar closed	Interval open	Interval closed
February 1946			
September 1951	1952		
17 February 1955	17 July 1957	29 months	
			26 months
13 September 1959	1 November 1960	13 months	
1962 or 1963?			
1 July 1966	20 December 1967	18 months	
			2 months
4 February 1968	9 February 1969	12 months	
			33 months
11 November 1971	March 1972	4 months	
			68 months
7 November 1977	21 December 1977	1 month	
			6 months
1 July 1978	13 November 1979	16 months	
			26 months
23 January 1982	10 September 1982	8 months	
Average		13 months	27 months



Appendix 3. Surface salinity samples taken from Wellstead estuary and Bremer river in January 1981.

Appendix 4. Surface salinity samples taken from Beaufort Inlet and Pallinup River in January 1981.

DEPARTMENT OF
FISHERIES AND WILDLIFE

108 Adelaide Terrace Perth
Western Australia 6000
Telephone 325 5988

Telegraphic Address:

Fishfaun. Perth

Enquiries

TO WHOM IT MAY CONCERN

The purpose of this letter is to introduce Research Officer, David Heald, whom I have asked to undertake a study of the success by amateur fishermen of net fishing in the Pallinup and Bremer estuaries.

By a decision of Government the Department of Fisheries and Wildlife is now responsible for the administration of fisheries in these two bodies of water. In taking over this responsibility I decided that I needed to have an understanding of the fisheries in terms of:-

1. The number of fishermen operating.

2. The species and size of fish caught.

3. The quantity of fish caught.

4. The success rate as compared to expectation of amateur fishermen.

I would be pleased if you would assist David by allowing him to accompany you when you pull your net, by allowing him to count and measure the fish caught (of all sizes), and just talking to him about the fishery in general.

Yours sincerely,

Bernard Bowen

Bernard K. Bowen.
Director.

11 December 1980.

Appendix 5. The letter of introduction given to the fishing public in the areas dealt with by the survey.

Appendix 6. Fish catches reported by different fishing parties using mainly 76 mm mesh set nets since 1 August 1981 in Wellstead estuary.

Date	No. Sets	No. Sea Mullet	No. Yellow-eye Mullet	No. Black Bream	No. Herring	No. Cobbler	Total Edible Fish
1/8/81	1	15	2	3			20
2/8/81	1	7	3	5			15
3/8/81	1	11		10			21
4/8/81	1	15		3			18
5/8/81	1	23					23
6/8/81	1	18	3	5			26
7/8/81	1	17		11			28
8/8/81	1	18	7				25
9/8/81	1	13	2	10			25
15/8/81	1	3	5	7			15
1/9/81	1	4		31			35
4-8/9/81	4	———	12 dozen fish	———			144
TOTALS	15	144	22	85			395
PROPORTION[A]		58%	9%	33%			

EDIBLE FISH MEAN CATCH RATE = 26 fish/set.

WELLSTEAD ESTUARY BROKE TO SEA 10.00 p.m. 23/1/82

24/1/82	1	2		15	4	2	23
27-30/1/82	4	21	4	20	17		62
13/2/82	3	12					12
25/2/82[B]	1			23	2		25
27/2/82	1	2		15			17
6/3/82	1	10		6	5		21
27/3/82	1	2		15			17
3/4/82[C]	1	3		9		1	13
TOTALS	13	52	4	103	28	3	190
PROPORTION		27%	2%	54%	15%	2%	

EDIBLE FISH MEAN CATCH RATE = 15 fish/set

A. Excludes data of 4-8/9/81

B. Taken with 102 mm (4") mesh net

C. Taken with 89mm (3½") mesh net.

32021/3/84—800—L/3672

WILLIAM C. BROWN, Government Printer, Western Australia

ISBN 0 7244 9309 3
ISSN 0726–0733